R&S®UPP
Audio Analyzer
User Manual

1411.1055.32 ─ 04

Test & Measurement

User Manual

ROHDE&SCHWARZ

This operating manual describes the Audio Analyzers

- R&S®UPP200
- R&S®UPP400
- R&S®UPP800

and their options.

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®UPP is abbreviated as R&S UPP.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

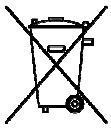
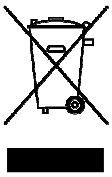
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF supply voltage
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Warning! Hot surface		Alternating current (AC)
	Protective conductor terminal		Direct/alternating current (DC/AC)
	Ground		Device fully protected by double (reinforced) insulation
	Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additonal information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
In the product documentation, the word ATTENTION is used synonymously.

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution severity 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the AC supply network, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the AC supply network. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

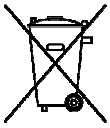
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

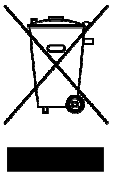
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO — Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.

ADVERTENCIA — Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.

ATENCIÓN — Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.

AVISO — Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.

2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

Quality management and environmental management

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde&Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde&Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear customer,
You have decided to buy a Rohde&Schwarz product. This product has been manufactured using the most advanced methods. It was developed, manufactured and tested in compliance with our quality management and environmental management systems. Rohde&Schwarz has been certified, for example, according to the ISO 9001 and ISO 14001 management systems.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,
Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests de ce produit ont été effectués selon nos systèmes de management de qualité et de management environnemental. La société Rohde&Schwarz a été homologuée, entre autres, conformément aux systèmes de management ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001

ROHDE&SCHWARZ
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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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ROHDE&SCHWARZ

1171.0200.22-06.00

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1 Contents of the Customer Documentation

The customer documentation for the R&S UPP consists of:

- Quick Start Guide
- Operating manual for the base unit and the options
- Service manual (English only)
- Context-sensitive online help
- Release Notes

The respective current version of the documentation is always available on the Internet (www.rohde-schwarz.com/downloads/manuals/upp.html).

Quick Start Guide

The printed quick start guide is part of the equipment supplied of the device. It contains information about the technical properties of the device, its commissioning, the fundamental operating steps and controls. The quick start guide is divided into three chapters:

- Commissioning
- Getting Started
- Manual Operation

Operating manual

The operating manual is located on the supplied CD-ROM. In addition to the chapters of the quick start guide, it contains the description of all device functions and the remote control of the device. Furthermore, it features notes for the preventive maintenance of the R&S UPP and for locating errors based on the warnings and error messages issued by the device. It is divided into the following chapters:

- Putting into Operation
- Getting Started
- Manual Operation
- Instrument Function
- Remote Control - Fundamentals
- Remote Control - Commands
- Maintenance and Instrument Interfaces

Service Manual

The service manual in English is located on the supplied CD-ROM. It contains all the necessary information to maintain the R&S UPP by replacing modules and to expand its functionality by installing options. The service manual is divided into the following chapters:

- Performance Test
- Adjustment

- Repair
- Firmware Update / Installing Options
- Documents

Context-sensitive online help

The context-sensitive online help provides support for the operation of the R&S UPP and its options – it describes the manual operation and the remote control. The online help is installed on the R&S UPP by default and is also supplied as external .chm file on the documentation CD-ROM.

Release Notes

The release notes describe the installation of the firmware, new and improved functions, problems solved and last-minute changes to the documentation. The corresponding firmware version can be seen on the cover sheet of the release notes. The current version of the release notes is available on the Internet (www.rohde-schwarz.com/downloads/firmware/upp.html).

2 Putting into Operation

The R&S UPP audio analyzer is available in three models. The 8-channel instrument R&S UPP 800, the 4-channel instrument R&S UPP 400 and the 2-channel instrument R&S UPP 200. The instruments are offered without display, without front panel controls and without CD/DVD drive. The three model variants are identical with respect to functions except for the number of channels and are handled together in the description.

This chapter describes the controls and ports of the R&S audio analyzer UPP based on the front and rear view and shows how to put the instrument into operation. It also describes the connection of peripherals such as printer, keyboard, mouse and monitor. Specifications for the interfaces can be found in the data sheet.

The introduction to chapter 3.1, "Introduction - Getting Started", on page 65 provides an overview of the functions and the operating concept of the audio analyzer. Detailed operating instructions and an overview of the menus are provided in chapter 4.1, "Introduction - Manual Operation", on page 100.

The CD-ROM contains the entire manual complete with the other chapters in printable PDF format: The individual menus and functions of the instrument including the associated remote-control commands are explained in detail in the reference section of chapter "Device Functions." Basic information on remote control of the instrument is provided in the chapters "Remote Control - Fundamentals" and "Remote Control - Commands". A detailed description of the instrument interfaces can be found in the chapter "Maintenance and Interfaces".

The audio analyzer is equipped with the Windows XP® operating system. No special knowledge of the operating system used is required for operating the instrument.

Basic PC knowledge, such as what a file, a directory, etc. is, or how data are transferred using Windows Explorer ® are assumed and, therefore, are not discussed in any detail.

The R&S UPP audio analyzer is operated via an external keyboard or mouse. Operation follows the same basic rules which apply to other Windows programs in use today. It is also assumed that users are familiar with these basic rules. This information is therefore not specified in detail here.

2.1 Description of the Front View

This section provides an overview of the control elements and connectors on the front of the R&S UPP. Specifications for the connectors can be found in the data sheet.

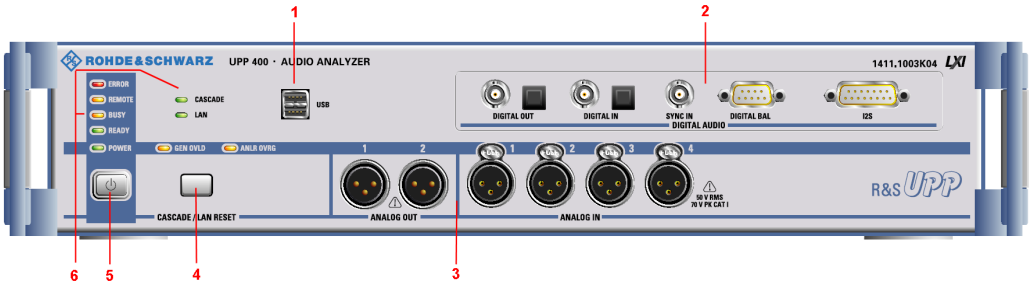


Fig. 2-1: Front view of the R&S UPP 400 (4-channel instrument), also representative for R&S UPP 200 (2-channel instrument) and R&S UPP 800 (8-channel instrument) with installed R&S UPP B4 (HDMI and digital audio interfaces) option.

1 = USB connectors
2 = Digital audio/HDMI interfaces or multichannel generator
3 = Analog audio interfaces
4 = LAN reset button
5 = STANDBY pushbutton
6 = STATUS LEDs

2.1.1 USB connectors

USB 2.0 ports (Universal Serial Bus) of type A (host USB).

- Connecting peripherals such as mouse, keyboard, printer
- Connecting a mass storage device such as a USB stick for transferring files

There are additional USB interfaces on the rear of the instrument.

2.1.2 Digital audio interfaces

Inputs and outputs for connecting digital consumer instruments and professional studio equipment.

Note

These interfaces are only available in conjunction with the R&S UPP B2 (digital audio interfaces) option installed!

DIGITAL OUT
BNC output for the SPDIF or AES/EBU format acc. to EIAJ CP-340 and optical output acc. to the TOSLINK system. A double-shielded BNC cable must be used to maintain EMC Class B.

DIGITAL IN
BNC input for the SPDIF or AES/EBU format acc. to EIAJ CP-340 and optical input acc. to the TOSLINK system. A double-shielded BNC cable must be used to maintain EMC Class B.

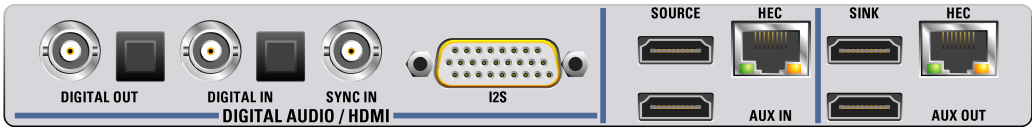
SYNC IN
BNC synchronization input for the generator instrument "Digital Audio" for the external synchronization options "Sync To" = "Ext DARS", "Ext Clock" or "Ext Inv Clock", and for the generator instrument "I2S" for "Sync To" = "Extern Masterclk" or "Ext Wordclk". A double-shielded BNC cable must be used to maintain EMC Class B.

DIGITAL BAL
9-pin D-Sub connector for connecting the symmetrical input and output signals for the SPDIF or AES/EBU format acc. to EIAJ CP-340; for the pin assignment, see chapter 5, "Instrument Function", on page 185. The R&S UPP Z2 cable option must be used to maintain EMC Class B.

I2S
25-contact D-Sub connector for connecting the input and output lines of the I²S interfaces; for the pin assignment, see chapter 5, "Instrument Function", on page 185. The R&S UPP Z3 cable option must be used to maintain EMC Class B.

2.1.3 Digital Audio/HDMI Interfaces

Inputs and outputs for connecting digital consumer instruments and professional studio equipment.



Note
These interfaces are only available in conjunction with the R&S UPP B4 (HDMI and digital audio interfaces) option installed!

DIGITAL OUT
BNC output for the SPDIF or AES/EBU format acc. to EIAJ CP-340 and optical output acc. to the TOSLINK system. A double-shielded BNC cable must be used to maintain EMC Class A.

DIGITAL IN
BNC input for the SPDIF or AES/EBU format acc. to EIAJ CP-340 and optical input acc. to the TOSLINK system. A double-shielded BNC cable must be used to maintain EMC Class A.

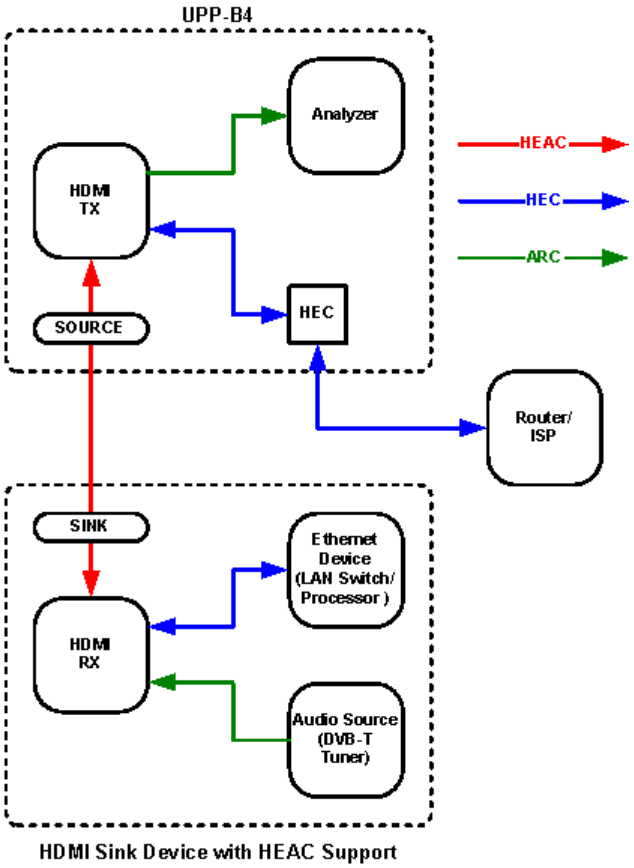
SYNC IN
BNC synchronization input for the generator instrument "Digital Audio" for the external synchronization options "Sync To" = "Ext DARS", "Ext Clock" or "Ext Inv Clock", and for the generator instrument "I2S" for "Sync To" = "Extern Masterclk" or "Ext Wordclk". A double-shielded BNC cable must be used to maintain EMC Class A.

I2S
26-contact D-Sub connector for connecting the input and output lines of the I²S interfaces; for the pin assignment, see chapter 5, "Instrument Function", on page 185. The R&S UPP Z4 cable option must be used to maintain EMC Class A.

SOURCE
HDMI 1.4 generator socket with HEAC support. Video formats can be generated internally or supplied via the AUX IN socket. The audio signals are always generated inside the device. To maintain EMC Class A, a suitable HDMI cable with multiple shielding and two ferrites (e.g. Würth Elektronik split ferrite 722-712-21) as well as a maximum length of 3 m is to be used.

AUX IN
Input socket for feeding an externally generated video signal. The video data, together with all the HDMI protocol data as well as info frames with the exception of the internally generated audio info frame, are combined with the internally generated audio data and output via the Source socket. To maintain EMC Class A, a suitable HDMI cable with multiple shielding and two ferrites (e.g. Würth Elektronik split ferrite 722-712-21) as well as a maximum length of 3 m is to be used.

HEC (SOURCE)
Decoupling of the Home Ethernet Channel at the HEC RJ-45 socket. The figure below shows a typical application scenario. The HDMI 1.4 implementation in the R&S UPP supports the Audio Return Channel (ARC) as well as the Home Ethernet Channel (HEC). Both signals are transferred together using a dedicated wire pair and referred to as HEAC. HDMI 1.4-compliant receiver and transmitter modules are capable of feeding and decoupling these two signals. An HDMI 1.4-compliant cable and an HDMI 1.4-compliant receiver with HEC support can be used to test its Ethernet functionality. A double-shielded Ethernet cable must be used to maintain EMC Class A.



SINK
HDMI 1.4 analyzer socket with HEAC support. Various measurement functions are available for the audio and video signals fed in at this interface. To maintain EMC Class A, a suitable HDMI cable with multiple shielding and two ferrites (e.g. Würth Elektronik split ferrite 722-712-21) as well as a maximum length of 3 m is to be used.

AUX OUT
The audio and video signals fed in at the HDMI Sink socket are connected through 1:1 to the AUX OUT output. A display device can be connected to this HDMI source to display the user interface of an AV receiver or a Blu-ray player. To maintain EMC Class A, a suitable HDMI cable with multiple shielding and two ferrites (e.g. Würth Elektronik split ferrite 722-712-21) as well as a maximum length of 3 m is to be used.

HEC (SINK)
Decoupling of the Home Ethernet Channel at the HEC RJ-45 socket. The figure below shows a typical application scenario. The HDMI 1.4 implementation in the R&S UPP supports the Audio Return Channel (ARC) as well as the Home Ethernet Channel (HEC). Both signals are transferred together using a dedicated wire pair and referred to as HEAC. HDMI 1.4-compliant receiver and transmitter modules are capable of feeding and decoupling these two signals. An HDMI 1.4-compliant cable and an HDMI 1.4-compliant source device with HEC support can be used to test its Ethernet functionality. A double-shielded Ethernet cable must be used to maintain EMC Class A.

2.1.4 Multi-channel generator

Generator with analog and digital outputs.

Note

This interface is only available in conjunction with the R&S UPP B8 (multichannel audio generator) option installed!

ANALOG OUT

Eight analog outputs brought out on the pins of a 25-pin D-Sub socket.

As an accessory for the optional R&S UPP B8 (multichannel audio generator), a break-out cable with a 25-pin D-Sub connector on the one side and eight XLR connectors on the other side is available (optional R&S UP-Z8A, refer to data sheet for Order No.).

DIGITAL OUT

Eight outputs in S/P DIF format in accordance with IEC 60958 (Unbal), which are brought out to a 9-pin D-Sub socket.

As an accessory for the optional R&S UPP B8 (multichannel audio generator), a break-out cable with a 9-pin D-Sub connector on the one side and five BNC connectors on the other side is available (optional R&S UP-Z8D, refer to data sheet for Order No.)

2.1.5 Analog audio interfaces

Output and input connectors (XLR) of analog generator and analyzer.

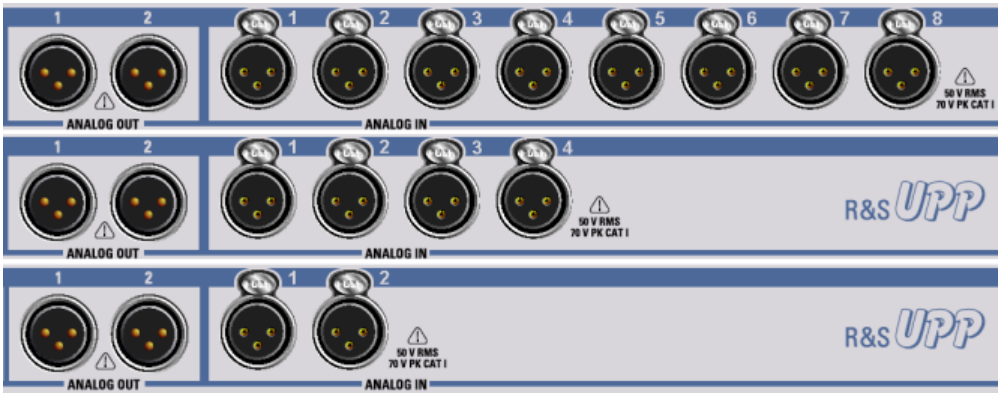


Fig. 2-2: R&S UPP variants from top to bottom: R&S UPP 800, R&S UPP 400, R&S UPP 200

NOTICE

Damage to the instrument

The instrument complies with measuring category I; make sure that the input voltage at the connectors of the analog analyzers does not exceed 50 V (effective, sinusoidal) and 70 V (peak value).

Do not use the instrument in measuring categories II, III and IV.

Explanation: Measuring circuits as defined in section 6.7.4 of EN61010-1: Measuring category I is intended for measurements on circuits which are not connected to the high-voltage current system.

ANALOG OUT 1 / 2
Two-channel generator signal at XLR connectors

ANALOG IN 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8
Depending on the R&S UPP variant 2, 4 or 8, analog XLR sockets as measurement inputs

2.1.6 LAN reset button

CASCADE / LAN RESET
The LAN RESET button has three functions:

- Configuration of an R&S UPP cascade:
  A short key press combines several UPP instruments into one measurement unit with more than 8 analog audio channels, see User Manual.
- Resets the LXI LAN default settings:
  Pressing and holding the key > 10 s sets the LXI LAN default settings to "DHCP + AutoIP / VXI-11 discovery on" and "restart of the device"
- Master PRESET:
  With the Master PRESET, you can easily get out of an unsuitable screen and monitor configuration and back to an operable instrument: Switch the instrument off and on again. During the software start, the ANLR OVRG-LED is illuminated briefly in yellow. As soon as this LED is illuminated in yellow, press the LAN RESET button briefly. The LED flashes for confirmation. Within the next 5 seconds, press the LAN RESET button again briefly. The Master PRESET is now carried out and forces a switchover to the external monitor with a screen resolution of 1024 x 768 pixels and the factory default settings.

2.1.7 STANDBY pushbutton

Used to switch the instrument alternately on and off. This requires that the power switch on the rear side of the instrument is switched on. If the instrument is switched on, POWER LED is green; if the instrument is switched off but in standby mode, POWER LED is yellow.

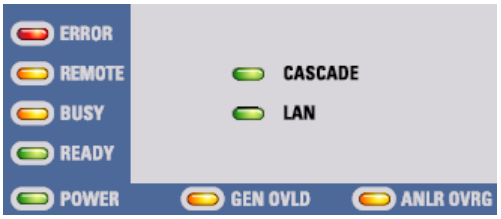
WARNING

Risk of electric shock

In standby mode, the instrument is supplied by the AC supply voltage!

The instrument must be set up in such a way that operation of the power switch is not obstructed.

2.1.8 Status LEDs



ERROR

- **LED is on steadily:** The instrument detected an error during the measurement
- **LED flashes:** The instrument detected an error during the configuration of the cascading

REMOTE

The instrument is controlled remotely

BUSY

The LED is on as long as the measurement is running

READY

The instrument is ready for operation and can be controlled manually or remotely

POWER

- **LED is yellow:** The instrument is in standby mode
- **LED is green:** The instrument is switched on

CASCADE

- **LED is on steadily:** The instrument is in cascading mode
- **LED flashes:** The instrument is in the configuration phase of a cascading

LAN

The instrument is integrated in a local network

GEN OVLD

- **LED is yellow:** The outputs of the audio analyzer were switched off by function "Output off".
- **LED is red:** The generator was switched off **at high impedance** because of an external signal feed at pin 2 or 3 with a voltage of ≥12 V peak against instrument ground.

The outputs can be switched on again, either

- by pressing CTRL+F12 on the external keyboard,
- switching the instrument off/on with the standby mode pushbutton or
- transmitting the SCPI command "OUTPut ON".

ANLR OVRG

- **LED is red:** One of the analog audio inputs is overloaded. The level of the are present signal is too high for the current band. Signals outside the IF "Bandwidth" can result in overranging.
- **LED is yellow:** One of the analog audio inputs is overloaded and could result in an inaccurate or unstable measurement result

2.2 Description of the Rear Panel

This section provides an overview of the connectors at the rear panel of the R&S UPP. Specifications for the connectors can be found in the data sheet.

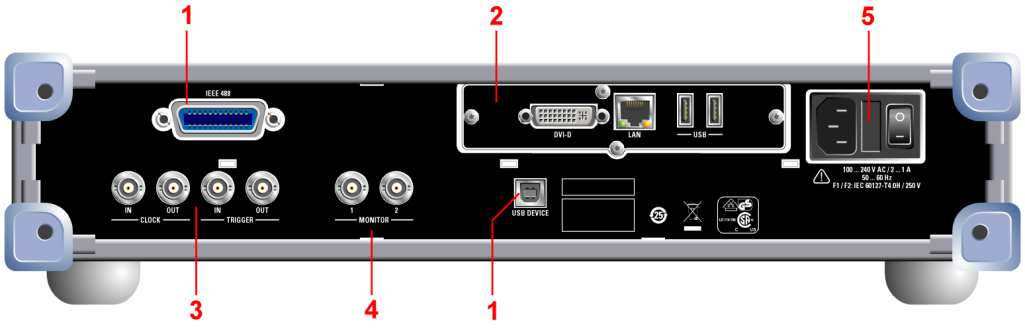
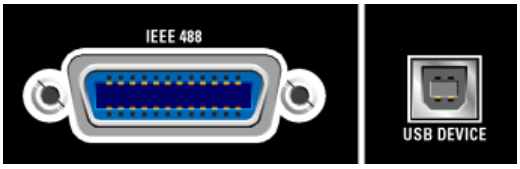


Fig. 2-3: Rear view of the R&S UPP

1 = Remote-control connectors
2 = PC interfaces
3 = Cascading connections
4 = BNC monitor outputs
5 = AC supply voltage connector

2.2.1 Remote-control connectors



IEEE 488
IEC/IEEE-bus connector (IEC 625/IEEE 488) for remote control of the instrument

USB DEVICE
USB 2.0 device connector for remote control of the instrument

2.2.2 PC interfaces

DVI-D
DVI-D socket for connecting an external monitor to the instrument. It is recommended to use a very well shielded cable with ferrite sleeves.

LAN
LAN interface for

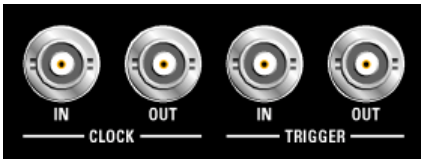
- integrating the audio analyzer in a network, e.g. for cascading several UPP instruments into one measurement unit with more than 8 analog audio channels
- Remote control of audio analyzer via remote desktop from a remote computer
- Remote control of audio analyzer via SCPI commands from a controller

USB
USB 2.0 ports (Universal Serial Bus) of type A (host USB).

- Connecting peripherals such as mouse, keyboard, printer
- Connecting a mass storage device such as a USB stick for transferring files

There are additional USB interfaces on the front of the instrument.

2.2.3 Cascading Connections



The use of a double-shielded BNC cable is recommended as connecting cable, whether for cascading devices or connecting a device under test.

CLOCK IN
Required for cascading and must be connected with CLOCK OUT of the previous instrument

CLOCK OUT
Required for cascading and must be connected with CLOCK IN of the next instrument

TRIGGER IN
This connector is required for cascading and must be connected with TRIGGER OUT of the previous instrument

TRIGGER OUT
- Required for cascading and must be connected with TRIGGER IN of the next instrument
- The trigger output level is 3.3 V
- Can be used for connecting to a device under test.

2.2.4 BNC monitor outputs

The instrument settings determine which signal is present at these BNC sockets:

- The input signal (maximum ± 5 V peak)
- The filtered signal from the analyzer (maximum ± 5 V peak)
- Starting with serial numbers 120100, 140100, 180100, a DC level (maximum ± 5 V)

The maximum output level is limited to ± 5 V peak

2.2.5 AC Supply Voltage Connector

AC supply voltage connector with integrated power switch

Shutting down the operating system

It is urgently recommended to shut down the operating system first before switching off the instrument via the power switch by switching off the instrument with the standby mode pushbutton (POWER LED should be orange before the shutdown).

AC SUPPLY VOLTAGE CONNECTOR

If the instrument is connected to the AC supply voltage, it automatically adjusts to the AC supply voltage (see the labeling for the voltage range). It is not necessary to manually adjust the instrument for a specific voltage or to change the fuse!

FUSE CARRIER

The fuse holder contains two fuses and is located between the AC supply voltage connector and the power switch. Both fuses protect the circuit.

POWER SWITCH

The power switch has two positions:

- 0: The instrument is disconnected from the AC supply
- 1: The instrument is supplied by the AC supply voltage. Depending on the activation of the standby mode pushbutton, the instrument is either in standby mode (POWER LED is yellow) or it is switched on (POWER LED is green)

2.3 Putting into Operation

The following section describes how to put the instrument into operation, connect external devices such as printer and monitor, and a connection of the audio analyzer with a network. It contains general safety instructions for instrument operation.

For information about installing options, see chapter 2.9, "Installing Options", on page 43.

For information about the firmware update, see chapter 2.11, "Firmware Update", on page 59.

CAUTION

Safety precautions

Be absolutely sure to follow the instructions in the sections below to prevent injury to people or damage to the instrument. This is particularly important if the instrument is used for the first time. The general safety instructions at the beginning of this manual must also be observed.

2.3.1 Unpacking the instrument

The instrument is delivered together with the accessories in one box. Proceed as follows to unpack its contents:

1. Remove the instrument from its packaging and check the shipment for completeness using the shipping document and the accessory lists for the various items.
2. First, pull off the protective plastic pads from the rear feet of the instrument and then from the front handles.
3. Remove the protective cover made of corrugated board from the rear of the instrument.
4. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
5. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. In this case, do not discard the box and packaging material.

Packaging material

It is recommended to retain the packaging. It is advisable to keep the original packing material in order to prevent control elements and connectors from being damaged in case the instrument is to be transported or shipped at a later date.

2.3.2 Setting Up the Instrument

The instrument is intended for indoor use. It can either be set up as a separate unit or mounted in a 19" rack.

The following ambient conditions at the location must be ensured:

- The ambient temperature must comply with the range specified in the data sheet.
- All fan openings must be clear, and the airflow at the openings of the side walls must not be impeded. The distance to the wall must be at least 10 cm.

NOTICE

Possible damage from electrostatic discharge

Electrical discharges can damage components of the instrument or a connected device under test.

For this reason, the instrument may be operated only at a workplace that is protected against electrostatic discharge.

The following methods can be used separately or in combination to protect against electrostatic discharges:

- Protective armband with grounding cable
- Conductive floor covering combined with use of a heel grounder

NOTICE

EMI Suppression

To suppress electromagnetic interference (EMI), the instrument may be operated only if it is closed and all covers are in place. The EMC class is listed on the data sheet.

The following conditions must be maintained to avoid interference:

- Use suitable double-shielded cables that are no longer than 3 m.
- Use only USB cables that are no longer than 1 m.
- Use only USB devices that adhere to the permissible EMC values.
- Terminate the outputs and cables with 50 Ω.
- Use only the cables R&S UP-Z2, R&S UP-Z3 and R&S UP-Z4 for the digital interfaces.
- Use the cable R&S UP-Z8A for the analog intercae of option R&S UPP-B8, and cable R&S UP-Z8D for the digital interface.

2.3.2.1 Separate installation

The R&S UPP can be set up on a level surface in horizontal position and with unfolded instrument feet.

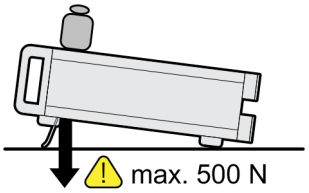
CAUTION

Risk of injury with unfolded instrument feet

The instrument feet can suddenly fold back if the instrument is being moved or the feet are not completely folded out. This can lead to personal injuries or damage to the instrument.

Instrument stability, and thus safe operation, is only ensured when the instrument's feet are completely folded out. Do not move the instrument and avoid performing work under it when the feet are folded out. Secure the instruments from slipping (e.g. by locking the instrument feet to the top of the front-panel frame).

If excessive loads are applied, the feet might break. The uniformly applied load to the feet when folded out must not exceed 500 N (including the weight of the instrument itself along with any equipment set on top of it).



2.3.2.2 Rack installation

A rack adapter (refer to data sheet for Order No.) is required for installation in a 19" rack. The mounting instructions are supplied with the adapter.

NOTICE

Possible damage to the instrument from overheating

Restricted airflow at the side wall openings can cause the instrument to overheat.

To ensure sufficient air supply, all fan openings must be clear and the airflow at the openings of the side walls must not be impeded. The distance to the wall must be at least 10 cm.

2.3.3 Connecting the R&S UPP to the AC Supply

NOTICE

Possible damage to the instrument

Before connecting and switching on the instrument, observe the following items to avoid any damage to the instrument:

- The tube for the housing has to be attached and screwed in place.
- The ventilation openings must be clear; ensure that air can freely exit at the holes on the sides. The minimum distance to the wall should therefore be at least 10 cm.
- The instrument must be dry.
- The instrument should only be operated in the horizontal position on an even surface.
- The ambient temperature must not exceed the range specified in the data sheet.
- It must be ensured that none of the voltage levels at the inputs exceed permissible limits.
- The instrument complies with measuring category I; make sure that the input voltage at the connectors of the analog analyzers does not exceed 50 V (effective, sinusoidal) and 70 V (peak value). Do not use the instrument in measuring categories II, III and IV.
  Explanation:
  Measuring circuits as defined in section 6.7.4 of EN61010-1
  Measuring category I is intended for measurements on circuits which are not connected to the high-voltage current system.
- The outputs of the instrument should not be overloaded and correct polarity must be ensured.

When the instrument is connected to an AC supply, it automatically adjusts to the AC supply voltage (see the labeling for the voltage range). It is not necessary to manually adjust the instrument for a specific voltage or to change the fuse!

2.3.3.1 Switching on the Instrument

1. Connect the audio analyzer to the AC supply by means of the supplied power cable.
   The R&S UPP is in compliance with safety class EN61010-1, it should only be connected to a socket with grounding contact.
   The power switch has two positions:
   - 0: The instrument is disconnected from the AC supply
   - 1: The instrument is supplied by the AC supply voltage. The boot process starts if an instrument that has been switched off is switched on using the power switch. Depending on the activation of the standby mode pushbutton, the

instrument is either in standby mode (POWER LED is yellow) or it is switched on (POWER LED is green)

2. The button on the front alternates between switching the instrument on and off. This requires that the power switch on the rear side of the instrument is switched on. If the instrument is switched on, the POWER LED is green; if the instrument is switched off but in standby mode, the POWER LED is yellow.

2.3.3.2 Start Screen and Booting of the R&S UPP

- **Without connected monitor**
  After switching on the instrument with the standby mode pushbutton, the POWER LED changes from orange to green. After a certain period of time, the BUSY LED lights up, followed by the READY LED. During this boot phase, the Windows XP operating system boots first followed by the instrument firmware. A self-test is carried out while instrument firmware is booted. The most recent instrument settings saved automatically at power-off are then loaded so that the instrument is in the same state as it was before power-off. If the READY LED is on, the instrument is ready for operation and can be operated via remote control.
- **With connected monitor, ext. keyboard and mouse**
  After the instrument is turned on, the BIOS version that is installed and the computer characteristics are displayed on the screen for several seconds. Afterwards, the Windows XP operating system boots first followed by the instrument firmware. A self-test is carried out while instrument firmware is booted. The most recent instrument settings saved automatically at power-off are then loaded so that the instrument is in the same state as it was before power-off. After booting is completed, the audio analyzer screen is displayed and the instrument can be operated manually via an external keyboard and a mouse or via remote control.

2.3.3.3 Restarting the R&S UPP

- **Without connected monitor**
  Press the standby mode pushbutton. The BUSY LED and the READY LED extinguish at the same time. The POWER LED changes from green to orange after a while. Press the standby mode pushbutton again. After the READY LED is green again, the instrument is ready for operation.
- **With connected monitor, ext. keyboard and mouse**
  If the R&S UPP firmware was closed without shutting down the operating system (e.g. by clicking on the ☒ icon in the title bar or ALT F4 on the keyboard), the program can be restarted with the mouse in two ways:
  – Clicking on the "R&S UPx firmware" icon on the desktop

– Clicking on the Start button in the taskbar, and then selecting the folders "All Programs, Rohde & Schwarz, UPP" and clicking on the "R&S UPx firmware" icon

- **With remote control**
  You can also shut down the operating system by using the "SYSTem:SHUTdown" command.

In case of an unexpected software lockup, the instrument can be rebooted only by switching the power switch on and off again and pressing the standby mode pushbutton. When using an external monitor, an external keyboard and a mouse, we recommend carrying out a warm start first using the shortcut Ctrl+Alt+Del (restart) or trying the Restart icon with the green arrow.

2.3.3.4 Switching Off

NOTICE

Risk of data loss

There is a risk of data loss if the R&S UPP is shut down without shutting down the operating system first. This may cause trouble during the boot process the next time the instrument is switched on.

We strongly recommend shutting down the operating system **before** switching off the instrument (SHUTDOWN button or via mouse operation). Shutting down the operating system ensures that open files are closed properly.

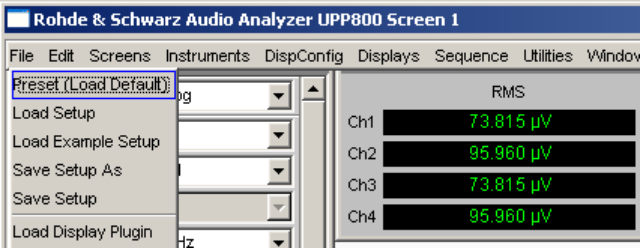
- **Without connected monitor**
  Press the standby mode pushbutton. The BUSY LED and the READY LED extinguish at the same time. The POWER LED changes from green to orange. If necessary, the power switch at the rear of the instrument can now be switched off without any problems to completely disconnect the instrument from the AC supply.
- **With connected monitor, ext. keyboard and mouse**
  – Click on Start, Shut Down, OK or the red Shutdown icon.
  – Shortcut Ctrl+Alt+Del, Shut down, OK

2.4 Function Check

The audio analyzer monitors the most important instrument functions automatically when it is switched on.

2.5 Presets

- **Without connected monitor**
  A preset can be executed only via the remote control command (Common Command) *RST.
- **With connected monitor, ext. keyboard and mouse**
  Open the menu bar and select "Preset (Load Default)".



The preset function sets all parameters and settings, even those of inactive operating modes.

The most important parameters set here are:

Generator frequency (analog)	1 kHz
Generator level (analog)	0.1 V
Generator signal	Sinusoidal
Generator frequency (digital)	997 Hz
Generator level (digital)	0.1 FS
Generator signal	Sinusoidal
Generator output impedance	25 Ω
Analyzer interface (analog)	XLR measuring input (analog)
Analyzer interface (digital)	Unbalanced input (BNC socket)
Analyzer function	RMS
Analyzer input impedance	200 kΩ
Frequency measurement	ON

2.6 Windows XP

NOTICE

Possible malfunction of the instrument function due to external software

The instrument operates under the Windows XP operating system. This allows external software programs to be installed on the instrument. The use and installation of commercial off-the-shelf (COTS) software may impair the instrument's functionality.

For this reason, we recommend that you only execute programs tested by Rohde & Schwarz with regard to their compatibility with the instrument software. In certain cases, the use of these programs may also impair the performance of the instrument.

The drivers and programs used in the instrument under Windows XP have been adapted to the measuring instrument. Existing instrument software must only be modified with update software released by Rohde & Schwarz.

Only the settings described below may be performed.

In its delivery state, the configuration of Windows XP is optimized to the functions of the audio analyzer. Changes in the system setup are only required when peripherals like a keyboard or printer are installed or in the event that the network configuration does not correspond to the default settings (see sections below). After switching on the audio analyzer, the operating system boots and the instrument firmware is started automatically without a password prompt (auto login).

Auto login is performed with the user name and the password "instrument". The standard user has administrator rights so that printer and network installations are possible.

The operating system can only be accessed if an external keyboard is connected. The Windows key on the external keyboard (next to the CTRL key) opens the Window XP start menu, and the Windows XP programs can be called up. Connecting a mouse makes Windows XP easier to use. The system settings under Windows XP are performed in the menu "Start – Settings – Control Panel" (see the description about Windows XP and the hardware for the necessary settings). The R&S UPP does not feature a diskette drive. Data is exchanged using a USB stick which is inserted into one of the USB interfaces. The USB stick is automatically assigned a free drive letter and the data can be transferred in Windows Explorer.

2.7 Connecting an External Monitor

NOTICE

Possible Impairments to Instrument Function

Make sure that the instrument is switched off before connecting the monitor. Otherwise, the monitor or the R&S UPP may be damaged.

Do not modify the screen driver (Display type) and the display configuration since this will impair instrument operation.

The R&S UPP provides the option of connecting an external monitor with DVI-D connection to the DVI-D socket at the rear of the instrument.

Connection

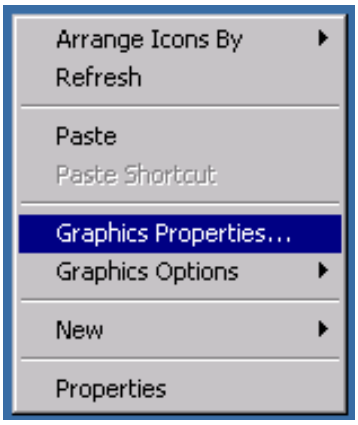
To prevent damage to the monitor and R&S UPP, the instrument must be switched off before an external monitor is connected. After connection, the external monitor is detected when the instrument is started (but not if it is connected while the instrument is in operation). The screen contents with all elements, e.g. panels, measurement displays, softkey bar, etc., appear on the external monitor. No further settings are needed.

2.7.1 Changing the Screen Resolution of the External Monitor

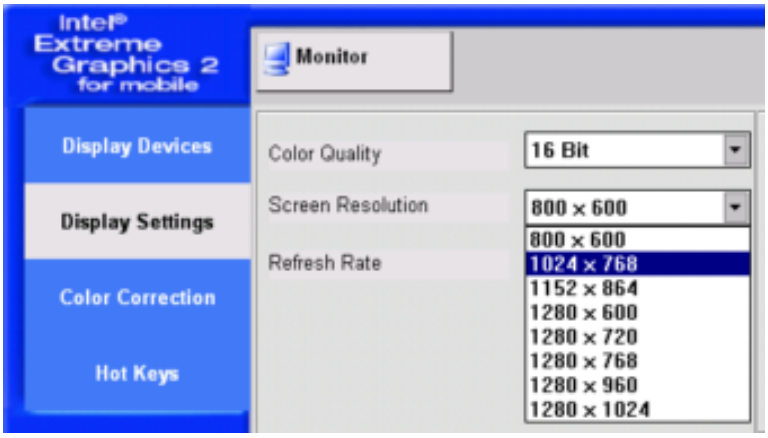
The R&S UPP audio analyzer is equipped with an internal computer. The setting of the screen resolution when using an external monitor is described below.

Setting external monitor resolution to higher than 800 x 600 pixels

1. Right-click on the desktop to open the following context menu.



2. Select "Graphics properties…".
3. Select "Display Settings", then select the desired resolution, e.g. "1024 by 768".

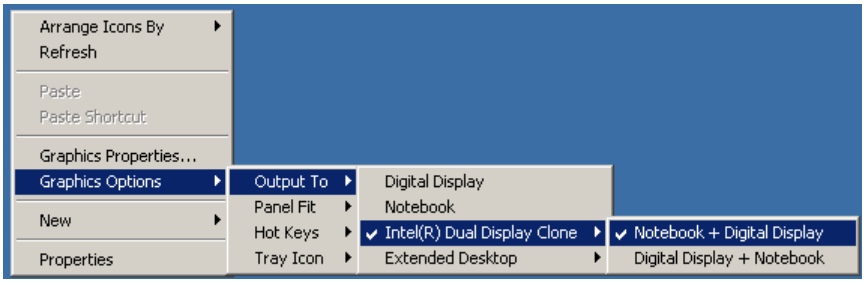


4. Click on "Apply".
5. Click "OK" to confirm the change, and then click "OK" again to close the window.

Resetting the External Monitor to a Resolution of 800 x 600 Pixels

The external monitor, mouse and keyboard are connected to the R&S UPP, the R&S UPP is switched on.

1. Exit or minimize the UPP program by clicking on the buttons on the right in the title bar.
2. Right-click on the desktop to open the following context menu again:



3. Select "Digital Display + Monitor".

   The resolution is reset to 800 x 600.

NOTICE

Switching Off the External Monitor

The external monitor is usually switched on each time the R&S UPP is started to correct any accidental changes to the monitor's starting configuration that may make it impossible to operate the instrument. If this measure does not show the usual user interface, connecting an external keyboard and using the shortcut CTRL + ALT + F4 will force the instrument to connect to the external monitor. The previously configured screen resolution remains intact.

2.8 Connecting External Keyboard and Mouse

2.8.1 Connecting an External Keyboard.

The R&S UPP allows connecting a commercially available, external keyboard with USB interface. A keyboard simplifies the input of list entries, comment texts, file names, etc. and is required for operating Windows XP.

The keyboard is connected to one of the USB interfaces at the front or rear of the instrument.

The keyboard is detected automatically when it is connected. The US keyboard assignment is the default setting. A change of the keyboard language assignment and special settings, such as the repeat rate etc., can be performed in the Windows XP menu "Start - Control Panel - Keyboard" or "Regional and Language Options". The menu is opened by pressing the Windows key on the external keyboard.

2.8.2 Connecting an External Mouse

The R&S UPP allows connecting a commercially available mouse with USB interface. The mouse makes it easier to move and resize the panels / graphical windows on the screen and provides alternative operating modes. This is recommended for convenient operation of Windows XP.

The mouse is connected to one of the USB interfaces on the front or rear of the instrument.

The mouse is detected automatically when it is connected. Special settings, such as the speed of the mouse cursor etc., can be performed in the Windows XP menu "Start - Control Panel - Mouse". The menu is opened by pressing the Windows key on the external keyboard.

2.9 Installing Options

The R&S UPP can be equipped with a few options. These options can be divided into two basic categories:

Software options	These can be installed by the user alone; installation instructions and a unique activation code supplied with the option are required.
Hardware options	These are installed in the R&S UPP audio analyzer, can be retrofitted only by a Rohde & Schwarz service facility.

2.10 Connect R&S UPP to a Network (LAN)

The R&S UPP has a network connector and can be connected to a LAN (Local Area Network).

Network administrators with the appropriate rights can transfer files across the network and use network resources such as the network directories or printers. The instrument can also be remote-controlled and manually operated in the network.

The manual remote allows operating the R&S UPP from any remote external computer. For example, the user can operate one or several R&S UPPs from his workplace that are integrated inn a test setup in another part of the building.

The R&S UPP is shipped with activated Windows XP firewall. File transfer via LAN or manual remote operation using the remote desktop requires only a partial exception in the firewall. It is advisable to coordinate the configuration of the firewall with the network administrator.

The remote control of the instrument via the LAN interface is described in chapter 6, "Remote Control - Fundamentals", on page 609.

2.10.1 Connection to the Network

NOTICE

Possible malfunction of the network operation

It is recommended that the connection of the instrument to the network be coordinated with the network administrator. Connection errors may affect the entire network.

Do not connect or disconnect the network cable until the instrument is switched off (standby). Only then can the network connection be reliably detected and impairments to instrument operation can be avoided.

The instrument is connected to the network using a commercially available RJ-45 cable connected to the LAN interface at the rear of the instrument.

2.10.2 Configuration of R&S UPP for Network Operation

The network interface operates with 100-MHz Ethernet IEEE 802.3u. The TCP/IP network protocol and the associated network services are preconfigured.

In order to exchange data in a local network (LAN), each connected computer or instrument must have a unique IP address or a unique computer name. In addition, network access of the different users is organized by the assignment of access rights.

The access rights determine which of the available network resources, e.g. file storage systems, are available for the R&S UPP.

Networks with DHCP

The R&S UPP is preconfigured for networks using DHCP (dynamic host configuration protocol). In these networks, the R&S UPP is automatically assigned an unused IP address.

In this case, a unique computer name is used for identification in the network. Every R&S UPP is assigned an individual computer name at the factory. This name can be queried in the Windows XP menu "Start - My Computer" and changed (see chapter 2.10.2.3, "Querying the computer name", on page 48).

Networks with fixed IP addresses

In networks using fixed IP addresses, the addresses are mostly assigned by the network administrator. The fixed IP address must be entered in the Windows XP menu "Start - Control Panel" (see chapter 2.10.2.2, "Entering the IP Address", on page 45).

Point-to-point connections

To set up a simple network – a LAN connection between an R&S UPP and a computer without integration in a larger network – an IP address must be assigned for the R&S UPP and the computer. The IP addresses 192.168.xxx.yyy are available, whereby both xxx and yyy can have the values 1 to 254; the value for the subnet mask is 255.255.255.0.

In this case, a commercially available crossover RJ-45 cable must be used for the connection.

User ID

For the R&S UPP, the user **instrument** has been defined. The user is used for the auto login when the instrument is started and for manual remote operation. The password is also **instrument**. By assigning the respective rights, the network administrator decides which directories and resources in the network can be accessed by the R&S UPP.

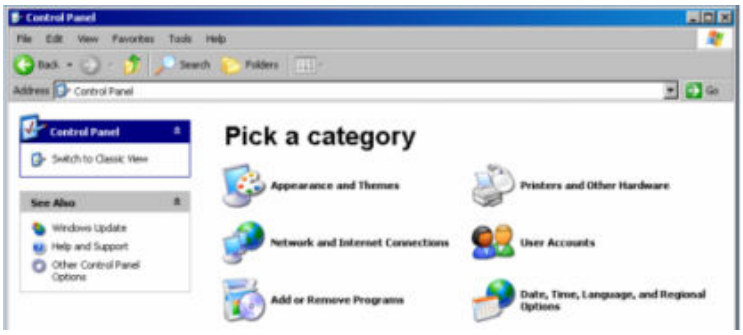
2.10.2.1 Preparations

The instrument is configured for network operation in the menus of the Windows XP operating system. The operating system can only be accessed if an external monitor and an external keyboard are connected; connection of a mouse is recommended for easy operation. The instrument should be switched off before the monitor, keyboard and mouse are connected. This will ensure that they are correctly detected by the operating system.

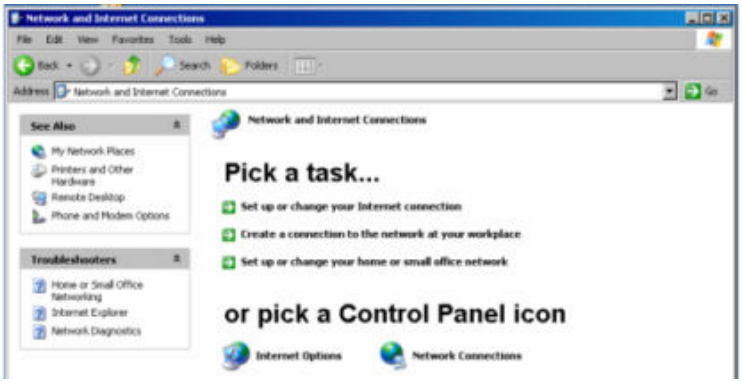
2.10.2.2 Entering the IP Address

By default, "Obtain an IP address automatically " (DHCP (Dynamic Host Configuration Protocol) is preset.

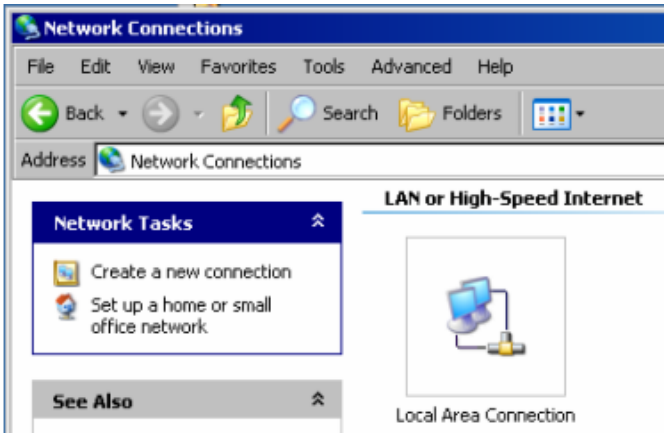
1. "Click on Start – Settings – Control Panel".



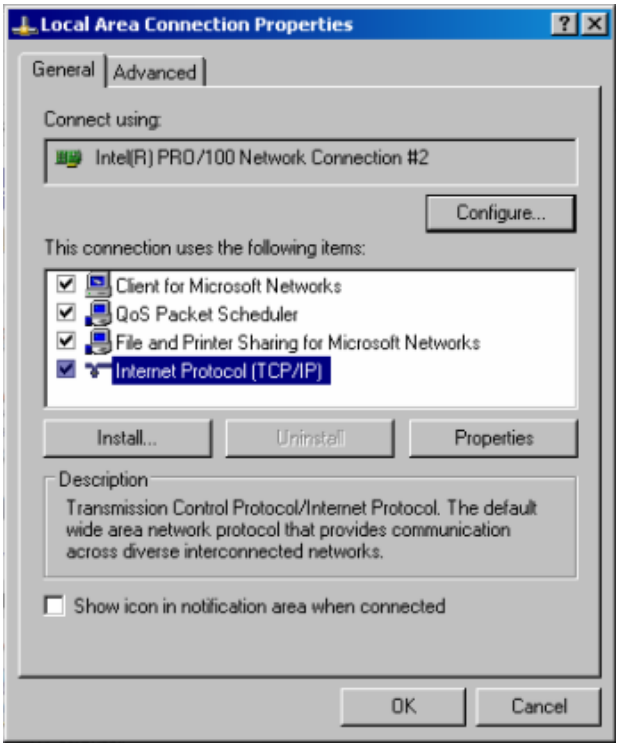
2. "Click on Network and Internet Connections" and then click on "Network Connections" at the bottom right in this menu.


Network and Internet Connections
Pick a task...
Set up or change your Internet connection
Create a connection to the network at your workplace
Set up or change your home or small office network
or pick a Control Panel icon
Internet Options
Network Connections

3. Right-click in the menu "Network Connections Local Area Connection" and then click on "Properties".



4. On the "General" tab in the field "This connection uses the following items:", mark the "Internet Protocol (TCP/IP)" selection and then click on "Properties".



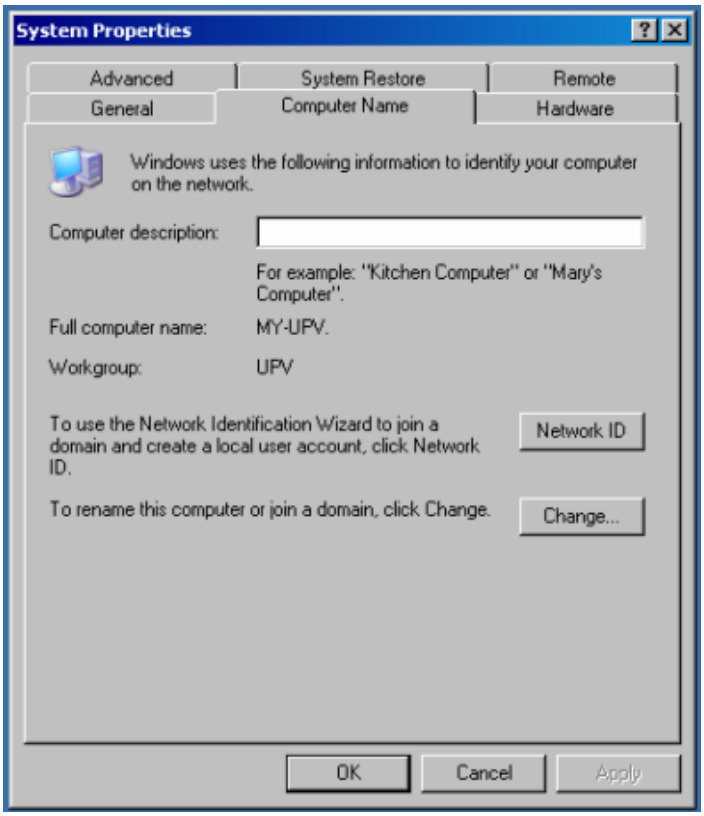
5. In the "Internet Protocol (TCP/IP) Properties" menu, enter the IP address in the "Use the following IP address" field (the complete data are available from the network administrator). Complete the entry with "OK" in all menus.

Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address: 192 . 168 . 201 . 50
Subnet mask: 255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

2.10.2.3 Querying the computer name

1. "Click on Start – Settings – Control Panel: Performance and Maintenance"
2. "Click on System" and select "Computer Name" in the tab menu.

   The computer name is displayed under "Full Computer Name". It can be changed in the "Change" submenu.



2.10.2.4 Accessing directories in the network

Access to network drives depends on access rights and whether the drives in question have been enabled. The complete integration of R&S UPP in a larger network with the required rights assignment is very complex and is generally performed by a network administrator.

Access from R&S UPP to the hard disk of a computer that is also connected to the network can, however, be performed relatively easy. The directory which the R&S UPP is to access simply has to be enabled on the remote computer. Access from R&S UPP to this directory is done with the help of a Windows XP search function.

This procedure is also of importance for a point-to-point connection, for instance in order to start a firmware update for which the files have been stored on the hard disk of the remote computer.

Both the computer and the audio analyzer must have a computer name and an IP address (see chapter 2.10.2, "Configuration of R&S UPP for Network Operation", on page 44).

The menu name may deviate from the name specified in the following operating sequence, depending on the language and on the operating system used on the computer.

Enabling the desired directory on the remote computer

1. On the computer, select the directory to be enabled in Windows Explorer and right-click to call up the "Properties" menu.
2. In the "Sharing" panel, activate the "Share this folder" check box.
3. Record the computer name of the PC (see chapter 2.10.2.3, "Querying the computer name", on page 48).

At the R&S UPP, access the enabled directory

1. Use the Windows key to call up the "Start" menu.
2. In the menu, select "Search Computers or People", followed by "A Computer on the Network".
3. In the input window with the query "Which computer are you looking for?", enter the name of the computer and start the search with Enter.

   The PC is listed with its computer name as the search result.
4. Click on the computer name. The enabled directory is displayed and the files stored in it can be used in the R&S UPP.

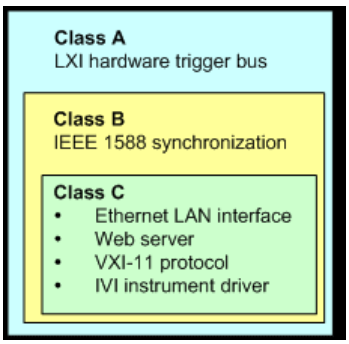
   Note: If a user name and password are requested when you click the computer, the login name and password used on the computer must be entered.

2.10.3 Configuration via LXI

LAN eXtensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB. This standard provides a new way for configuring virtual front panel instruments by using a network and a Web interface. The main tool for this configuration method is a browser, such as Microsoft Internet Explorer, but it is also possible to use other browsers such as Firefox or Netscape.

2.10.3.1 LXI classes and LXI functionality

LXI-compliant instruments are divided into three classes, A, B and C, with the functionality of the classes hierarchically based one upon the other:



- Class C instruments are characterized by a common LAN implementation, including an ICMP ping responder for diagnostics. The instruments can be configured via a web browser; a LAN Configuration Initialize (LCI) mechanism resets the LAN configuration. LXI instruments of class C must also support automatic detection in a LAN via the VXI-11 discovery protocol and programming by means of IVI drivers.
- Class B adds IEEE 1588 Precision Time Protocol (PTP) and peer-to-peer communication to the base class C. IEEE 1588 allows all instruments on the same network to automatically synchronize to the most accurate clock available and then provide time stamps or time-based synchronization signals to all instruments with exceptional accuracy.
- Class A-instruments are additionally equipped with the eight-channel hardware trigger bus (LVDS interface) defined in the LXI standard.

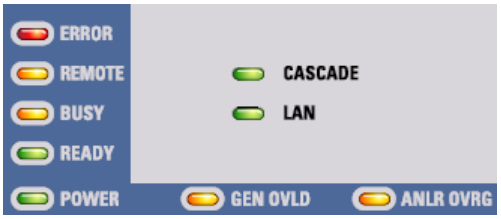
Instruments of classes A and B can generate and receive software triggers via LAN messages and communicate with each other without involving the controller.

The R&S UPP meets the general requirements of LXI Class C. In addition to the properties described above, the instrument offers the following LXI-related functions:

- Integrated display of the current instrument settings
- Possibility of remote controlling the instrument within the WEB browser.

2.10.3.2 LXI LAN Indicator

The green LAN LED on the front panel of the R&S UPP shows the LAN status of the instrument. The LAN LED indicator has three states.



- LAN LED off
  - The instrument does not have valid IP address. This may be due to one of the following reasons:
    1) the instrument is configured with DHCP, but no DHCP router is connected,
    2) the instrument is manually configured and an IP address conflict is present,

3) the instrument lost its IP address that was configured with DHCP and switched to Auto IP.
This state is called "error state" and normally can be resolved by the LCI mechanism (LAN reset). This mechanism is required by the LXI standard and can be invoked with the "LAN RESET" button (key press > 10 s) on the front side of the instrument (see chapter 2.2, "Description of the Rear Panel", on page 29).

- LAN LED is on
  – The instrument has a valid IP address and is reachable via TCP/IP.
- LAN LED flashes
  – The instrument is in the "Device Indicator" state initiated by the WEB interface. This state is required by the standard and is used for finding instruments in racks (see chapter 2.10.3.4, "LXI Browser Interface", on page 51).

2.10.3.3 LXI Default State of Network Settings

After a LCI (LAN reset), the instrument automatically reboots and starts up with following LAN settings:

Parameter	Setting
Hostname	RSUPPvvv-xxxxxx
Description	Audio Analyzer
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
ICMP Ping	Enabled
Negotiation	Auto Detect
VXI-11 Discovery	Enabled
Password for LAN Configuration	LxiWebIfc

More information about the LXI standard is located on the LXI website under
http://www.lxistandard.org
or in the article about LXI in
"News from Rohde & Schwarz, 2006/II - 190".

2.10.3.4 LXI Browser Interface

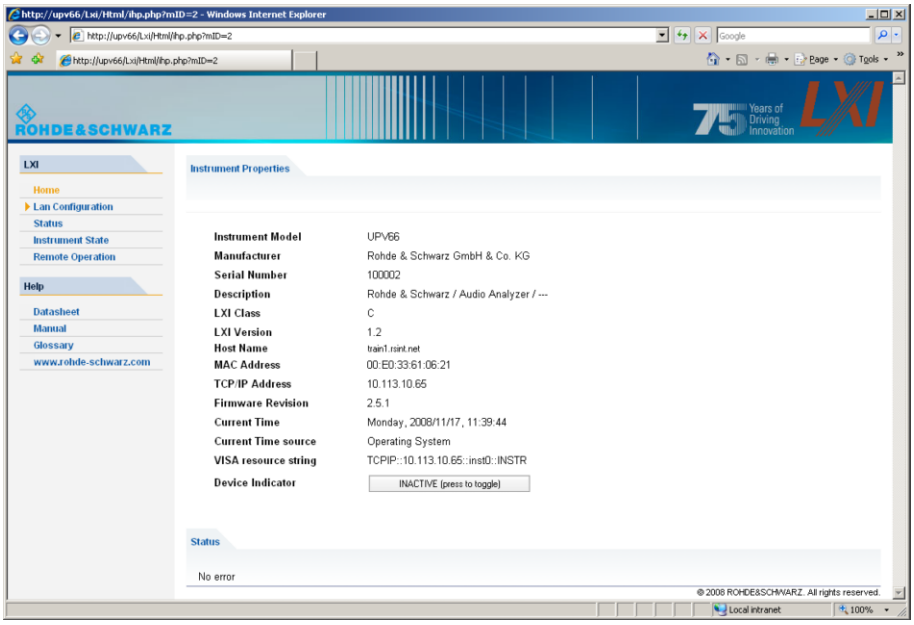
The only information necessary for performing configuration via the LXI/Web interface is the name of the instrument (which means its Windows name) in networks that operate with DHCP enabled, or its IP address in networks that operate with manual network configuration. In rare cases where neither one of these names is known, it is also possible to derive the IP address from the MAC address, which is printed on the rear panel of the instrument.

The instrument's LXI browser interface works correctly with all W3C compliant browsers.

To start the instrument home page (welcome page), open a browser on the PC and enter the instrument name or the IP address of R&S UPP in the address field, e.g.

http://rsUPP800-100002 or http://10.113.10.203.

The instrument name for the R&S UPP is always RSUPPvvv-xxxxxx, whereby vvv represents the variant and xxxxxx the six-digit serial number of the instrument.



The instrument home page shows all important information in a compact form. The MAC address and the (often dynamically assigned) IP address as well as the complete resource string for the remote control via VISA are also located here (see also chapter 6, "Remote Control - Fundamentals", on page 609).

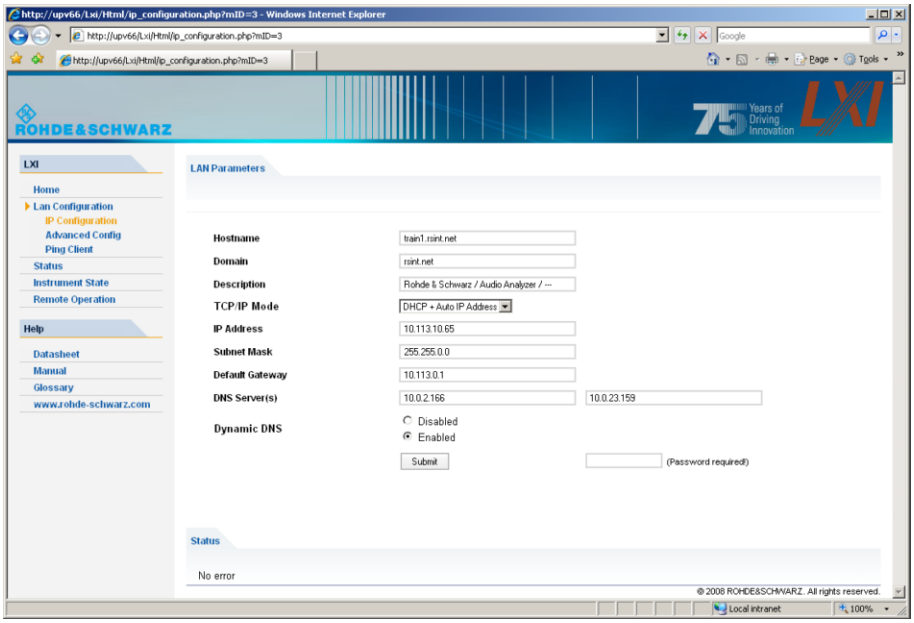
The LAN indicator on the instrument will blink if Device Indicator is set to ACTIVE. Clicking on "INACTIVE (press to toggle)" switches the status on and off. It can be used to quickly identify an instrument that is mounted together with several other instruments of the same type, such as in a 19" rack.

Clicking on "ACTIVE (press to toggle)" switches the flashing state off again.

The left side shows a navigation bar containing the important "LAN Configuration" menu. This page of the LXI Web configuration website enables extensive configuration of all important LAN parameters, which is necessary because the configuration steps mentioned in the next sections cannot be performed as described with a virtual front panel instrument.

Changing the LAN configuration is password-protected. The password reads LxiWebIfc (notice upper and lower case characters). This password cannot be changed in the current firmware version.

2.10.3.5 IP Configuration



- TCP/IP Mode
  - decides whether DHCP is switched on or not. The IP Address, Subnet Mask, Default Gateway and DNS Server configuration fields are only enabled if DHCP is disabled. Consult the network administrator if it is necessary to modify these settings or any other settings.

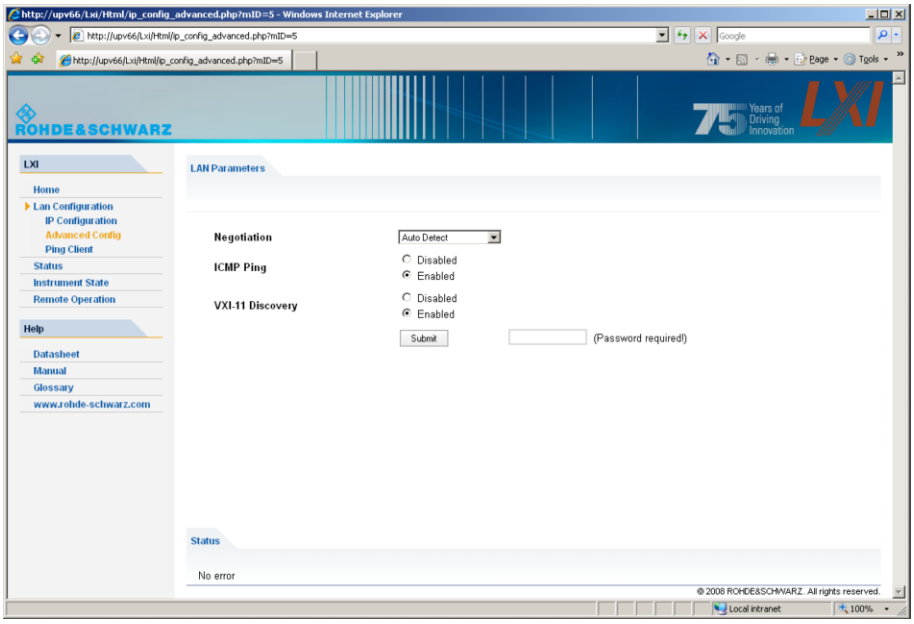
Switching from DHCP enabled mode to manual configuration mode may trigger an instrument restart when the new setting is confirmed (depends on the configuration). If incorrect network configuration settings have been entered, LAN RESET on the rear panel of the instrument must be used to restore access to the Web interface.

- IP address
  - Allows the IP address of the instrument to be modified if DHCP is disabled.
- Subnet mask, default gateway
  - are settings that may have to be changed at times compared to the displayed presets if DHCP is switched off. Consult the network administrator for the proper values if it is necessary to modify these settings.
- DNS server
  - This is the IP address of the domain name server of the network segment. Consult the network administrator if it is necessary to modify this setting when operating with DHCP disabled.
- Dynamic DNS

– Allows different DNS servers to be addressed in succession. Consult the network administrator if it is necessary to modify this setting when operating with DHCP disabled.

2.10.3.6 Advanced LAN Configuration

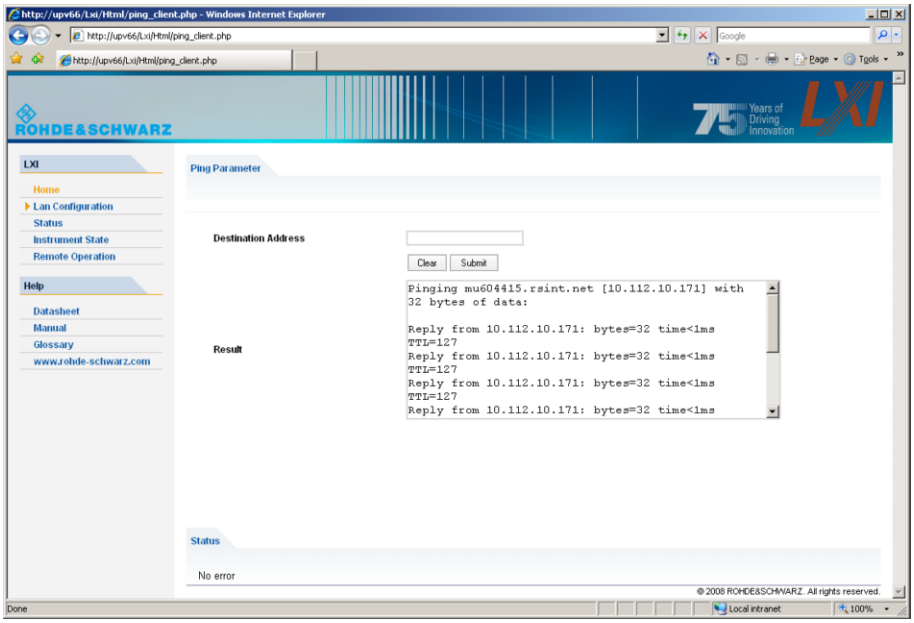
"Advanced LAN Configuration" provides LAN settings that are not declared mandatory by the LXI standard. These advanced parameters should only be modified by experienced users.



- Negotiation
  – The Negotiation configuration field provides different Ethernet speed and duplex mode settings. In general, the Auto Detect mode is sufficient.
- ICMP Ping
  – ICMP Ping must be enabled to use the ping utility.
- VXI-11 Discovery
  – Enables or prevents discovering the instrument via the VXI-11 Discovery protocol, which is a protocol jointly developed by National Instruments and VISA for searching for devices on a LAN.
  VXI-11 is the protocol that is used for discovery of the instrument in the LAN. According to the standard, LXI instruments must use VXI-11 to provide a discovery mechanism; other additional search methods are permitted.

2.10.3.7 Ping Client

Ping is a utility that verifies the connection between the LXI-compliant instrument and another instrument. The ping command uses the ICMP echo request and echo reply packets to determine whether the LAN connection is functional. Ping is useful for diagnosing IP network or router failures.



The ping utility is not password-protected.

To initiate a ping between the LXI-compliant instrument and a second connected instrument:

1. "Activate ICMP Ping" on the "Advanced LAN Configuration" page (activated after LCI).
2. Enter the IP address of the second device without the ping command and without any further parameters into the Destination Address field (e.g. 10.113.10.203).
3. Click on "Submit".

2.10.4 Configuration for manual remote operation

The R&S UPP can be operated manually from an external computer via a network connection. The Windows program Remote Desktop Connection is used for operation, see chapter 4.16, "Manual Remote Operation", on page 171.

Manual remote control of the audio analyzer is possible under the following conditions:

- the Windows 95 operating system or higher and the Remote Desktop Connection program are installed on the external computer and a LAN interface is configured for the network
- the audio analyzer and the computer are connected via LAN (see chapter 2.10.2, "Configuration of R&S UPP for Network Operation", on page 44),
- the Remote Desktop Connection program is activated on the audio analyzer (see chapter 2.10.4.1, "Activating the Remote Desktop Connection program at the R&S UPP", on page 56),

- on the external computer, the R&S UPP data have been entered in the Remote Desktop Connection program (IP address or computer name of R&S UPP in the network (see chapter 2.10.2.3, "Querying the computer name", on page 48),
- the login at the external computer for R&S UPP was performed with the correct user name (instrument) and the correct password (instrument) (see chapter 2.10.4.2, "Starting manual remote operation at the external computer", on page 57).

2.10.4.1 Activating the Remote Desktop Connection program at the R&S UPP

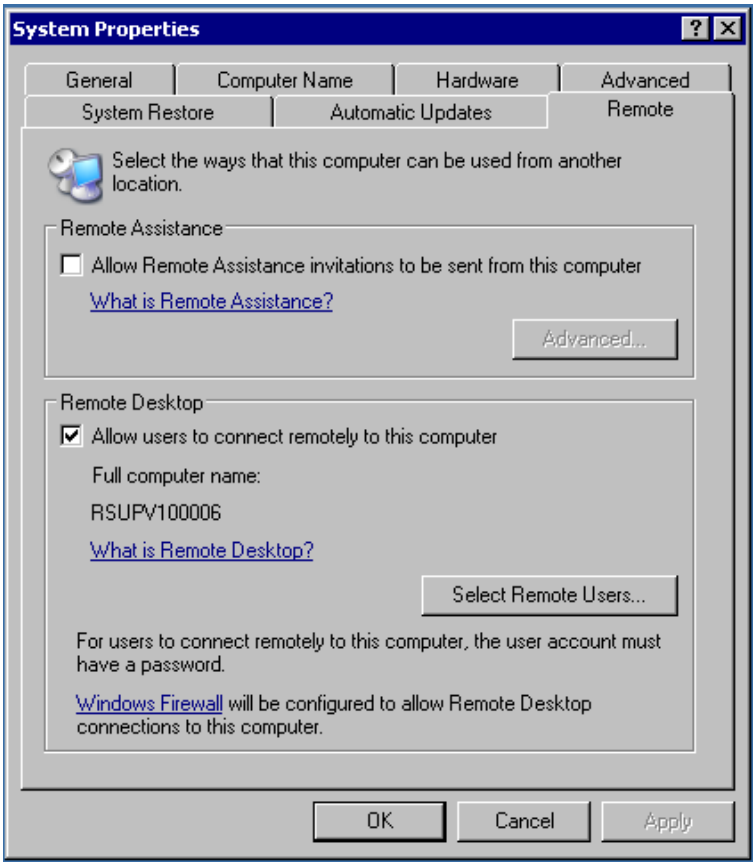
NOTICE

Unauthorized access possible to audio analyzer

After activating Remote Desktop, access to this R&S UPP is possible for any user in the network who knows the computer name and the login data of the audio analyzer.

Activating Remote Desktop

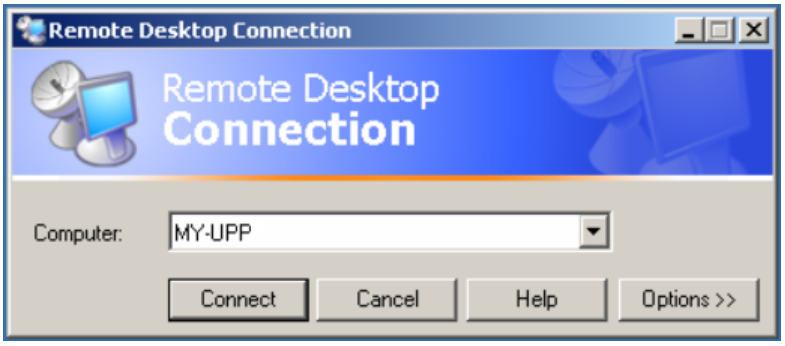
1. "Start – Settings – Control Panel": Click on "Performance and Maintenance".
2. "Click on System" and select "Remote" in the tab menu.
3. Activate the "Allow users to connect remotely to this computer" check box.



2.10.4.2 Starting manual remote operation at the external computer

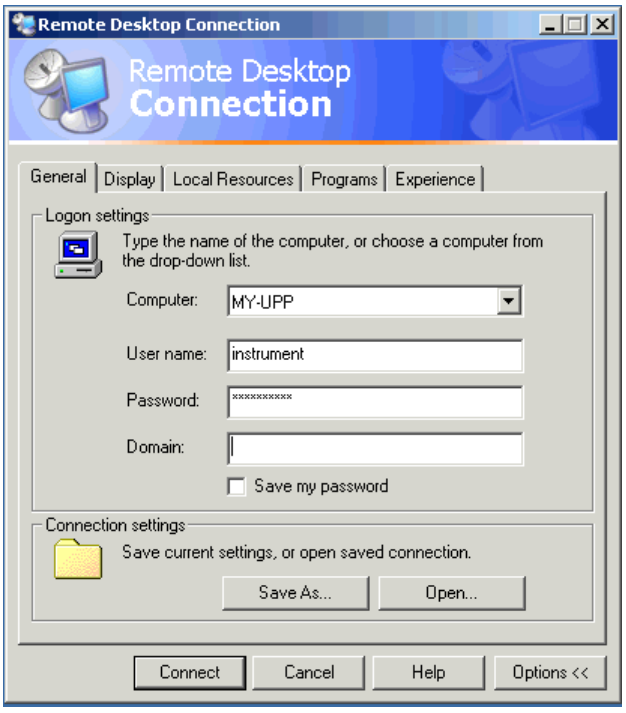
The Remote Desktop Connection program is already installed in the Windows XP operating system. For all other Windows operating systems from Windows 95 and higher, the program can be downloaded free-of-charge from the Internet (http://www.microsoft.com). It can be loaded onto any external computer by following the instructions, which are also provided on the Internet.

1. If necessary, install the **Remote Desktop Connection** program on the external computer
2. Start the program in the Windows menu "Start - All Programs - Accessories - Communications".



Before the program can be used for the first time, the instrument and user ID of the R&S UPP must be entered on the external computer. The instrument ID - the computer name of R&S UPP - identify the R&S UPP in the network. Every R&S UPP is supplied together with a computer name which can be used for manual remote operation. Querying the computer name is described in chapter 2.10.2.3, "Querying the computer name", on page 48.
The user ID is necessary as it authorizes access to the R&S UPP. They are preset on the R&S UPP and are "instrument" for both the user name and the password. No entry is needed in the Domain field.

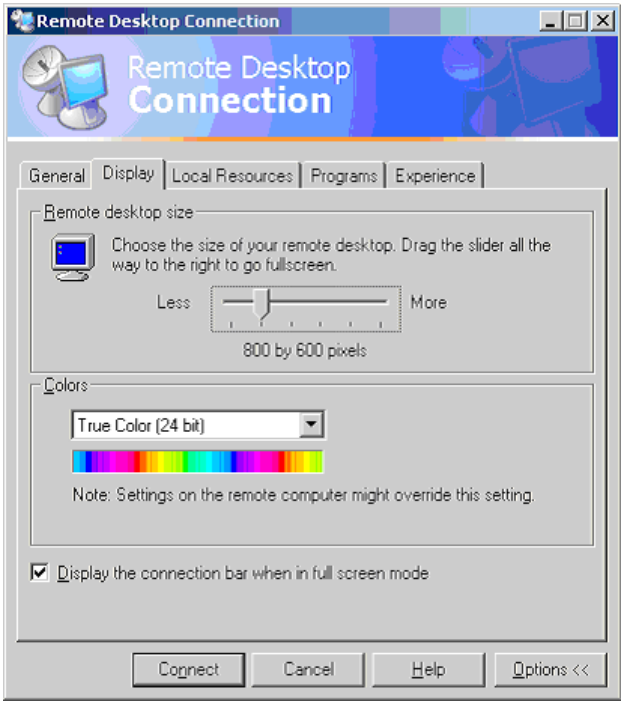
3. Enter the instrument and user ID on the "General "tab of the extended "Remote Desktop Connection" menu (called up by pressing the "Options>>" button).



4. The login data can be saved with the "Save as" button.
When saving as `default.rdp` file, the connection to R&S UPP is offered as default at the start of the program. When saving under a different name, the setting

for the connection with R&S UPP is provided in the selection list which is called up by clicking on the button in the "Computer:" entry line.

5. The resolution for the display of the R&S UPP monitor is set to 800 x 600 on the Display tab.



6. Establish the connection by clicking on the "Connect" button.
After the connection has been established, the audio analyzer screen appears on the external computer. Operation is possible with the mouse and/or the keyboard. If several R&S UPPs should be manually remote-controlled by one computer, a separate Remote Desktop Control window must be opened for every R&S UPP. This is possible by repeatedly starting the program on the external computer.

2.11 Firmware Update

The firmware of R&S UPP is supplied in a file with the name `Setup-xxxxRelease.exe` . The sequence of digits for `xxxx` consists of the main version number followed by the subversion number, revision number and build number.

It is required to connect an external monitor, an external keyboard and a mouse.

The initial installation and firmware updates are carried out by starting this EXE file. By doing this you start an Installer program which automatically checks which type of installation is necessary:

Main installation	The Installer displays what it has found out about the environment into which the firmware will be installed and how much disk space is needed. It then takes you through the "Setup Wizard". Normally, the "Next" button is always used to continue.
Major update	The Installer detects that the installed firmware is too old for a minor update to be carried out. It therefore displays a message asking you to uninstall the old software completely.
Minor update	The Installer simply displays a short prompt asking whether you wish to update the firmware. The rest is performed automatically.

2.11.1 Troubleshooting during a Firmware Update

The two most common problems that can occur when installing the software (or during a major update) are these:

- At the beginning, just before the progress bar starts, the progress window displays the text "InstallShield is preparing InstallScript". Occasionally you then see an error message and installation is canceled.
  This problem can usually be solved by restarting Windows and carrying out the firmware installation again.
- After the installer has installed the firmware, i.e., the progress bar is completely filled, the progress window displays the text "Removing Backup Files", "Registering Components" or "Publishing Product Information". Here, too, it occasionally happens that an error message is followed by a second message, and the firmware is subsequently not installed.
  This problem can sometimes be solved by restarting Windows and carrying out the setup again. If the error occurs again, this can be for two reasons:
  – Installation of the front panel driver went wrong. In this case, it must be installed using the Windows wizard; the required INI file is named `C:\UPV\fpnl_wdm.inf`. You should now reinstall the firmware.
  – The installation of additional Windows settings went wrong. In this case, execute the files `C:\UPP\ScanFirmwareVersions.exe` and `C:\UPP\SetReg.exe` in succession. You should now reinstall the firmware.

  If neither of these steps is successful, the instrument needs to go in for service (or the Windows image program must be reloaded).

2.12 Windows XP Recovery and Backup

The R&S UPP provides an invisible backup and recovery partition. A backup of the factory system partition `(C:\)` is saved by default and can be restored in case of a system crash.

In addition, backups of up to 5 firmware versions can be stored on this partition. It is e.g. possible to backup the current system partition prior to a firmware update or to provide different system configurations for different environments.

For the R&S UPP, the connection of an external keyboard is required.

The operation is described with respect to an external keyboard. It is recommended to connect a mouse that allows an intuitive operation!

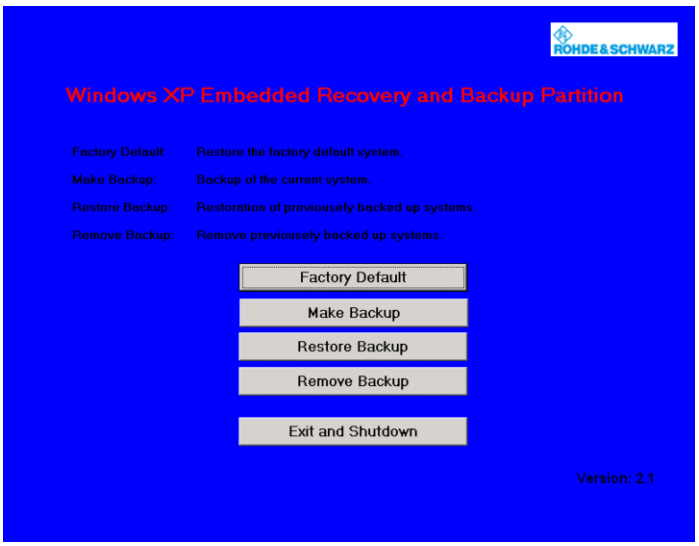
During restore, the system partition `(C:\)` is deleted, formatted and rewritten. The data partition `(D:\)` is not affected by this.

2.12.1 Calling the Windows XP Recovery and Backup Partition Menu

If several backups are already stored on the disk, the remaining space might not be sufficient for an additional backup. In this case a warning is indicated in the Windows XP Recovery and Backup Partition menu and the user is requested to remove an old backup before making a new one.

1. Switch the instrument off and on again **Press the cursor keys multiple times during the boot phase to ensure that the Boot menu does not independently close after a short period of time.**
2. In the Boot menu, use the cursor keys to select the"Backup/Recovery" line.
3. Open the "Windows XP Recovery and Backup Partition" menu with ENTER.

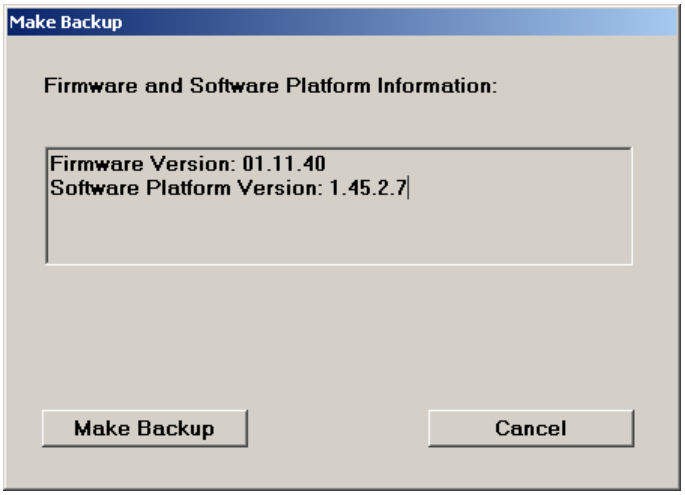
   The menu shows the available selections for the recovery and backup partition:


ROHDE&SCHWARZ
Windows XP Embedded Recovery and Backup Partition
Factory Default: Restore the factory default system.
Make Backup: Backup of the current system.
Restore Backup: Restoration of previously backed up systems.
Remove Backup: Remove previously backed up systems.
Factory Default
Make Backup
Restore Backup
Remove Backup
Exit and Shutdown
Version: 2.1

2.12.2 Backup Current System Partition

1. In the Windows XP Recovery and Backup Partition menu, use the cursor keys to select the "Make Backup" button.
2. Open the "Make Backup" menu with the ENTER key.

   The menu shows the current versions of the firmware and the software platform.



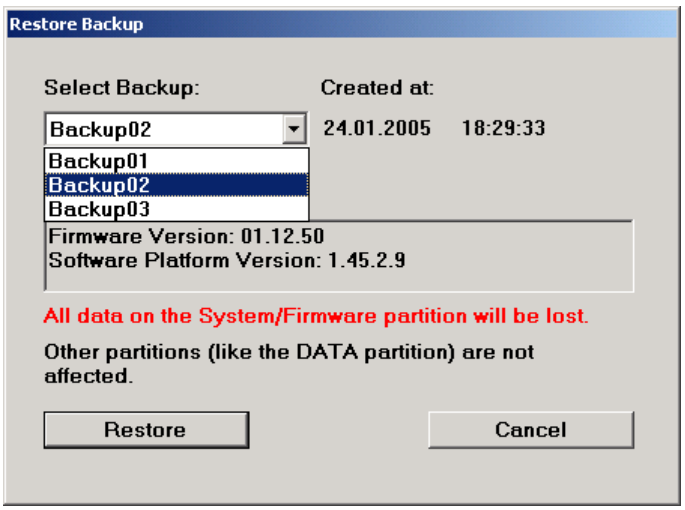
3. Select the "Make Backup" button with the TAB keys.
4. Start the backup by pressing the ENTER key.

   After the backup, the "Windows XP Recovery and Backup Partition" menu appears again.
5. Select "Exit and Shutdown" with the cursor keys.
6. Exit the program and shut down the R&S UPP with the ENTER key.

2.12.3 Restoring a Selected Version of the System Partition

1. Use the cursor keys to select "Restore Backup" in the "Windows XP Recovery and Backup Partition" menu to select the desired version of the system partition.
2. Open the "Restore Backup" menu with the ENTER key.

   The menu shows the versions of the firmware and the software platform of the backup which is displayed in the "Select Backup" window.



3. Select the "Select Backup" window with the TAB keys.
4. Select the backup to be restored with the up/down cursor keys and the ENTER key.
5. Select the "Restore" button with the TAB keys.
6. Start the restore process with the ENTER key.

   The script that is performed during recovery is displayed.
7. After the restore, shut down and switch off the R&S UPP.

   The new setting is now active.

2.12.4 Recover Factory Default

1. Select the "Factory Default" button in the Windows XP Recovery and Backup Partition menu with the cursor keys to recover the factory default version of the system partition.
2. Open the "Factory Default" menu with the ENTER key.

   The menu shows the versions of the firmware and the software platform on delivery.

Factory default
Attention
This will recover the installation of Windows XP Embedded (TM).
All data stored on the System/Firmware partition will be lost.
Other partitions (like the DATA partition) are not affected.
Firmware and Software Platform Information:
Firmware Version: 01.11.38
Software Platform Version: 1.45.2.7
Recover now
Cancel

3. Select the "Restore now" button with the TAB keys.
4. Start the restore process with the ENTER key.

   The script that is performed during recovery is displayed.
5. After the restore, shut down and switch off the R&S UPP.

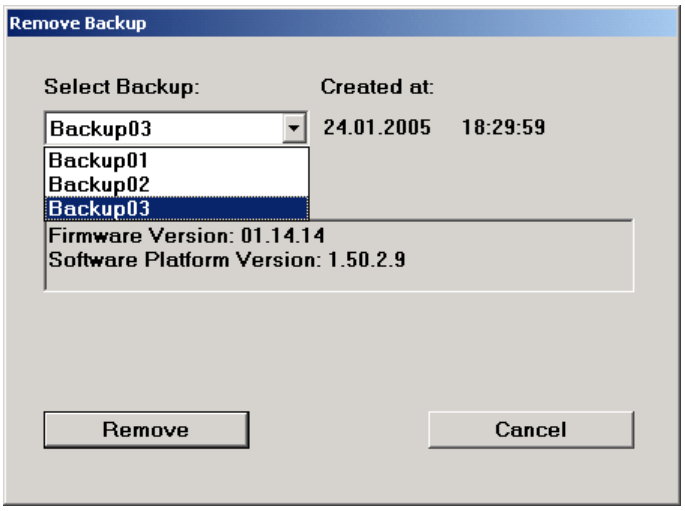
   The new setting is now active.

2.12.5 Deleting Backups

Up to five backups in addition to the factory default can be stored on the recovery partition. To provide space for new backups, it might be necessary to remove older backups. The factory default cannot be deleted.

1. Use the cursor keys to select the "Remove Backup" button in the Windows XP Recovery and Backup Partition menu to delete a selected backup.
2. Open the "Remove Backup" menu with the ENTER key.

   The menu shows the versions of the firmware and the software platform of the backup displayed in the Select Backup window.



3. Select the "Select Backup" button with the TAB keys.
4. Use the cursor keys and the ENTER key to select the backup to be removed.
5. Select the "Remove" button with the TAB keys.
6. Start the removal process with the ENTER key.

   After the deletion, the instrument returns to the Remove Backup menu as long as backups are still available. If the last backup is deleted, the Windows XP Recovery and Backup Partition menu opens again.
7. Select the "Cancel" button with the TAB keys.
8. Close the "Remove Backup" menu with the ENTER key.

   The Windows XP Recovery and Backup Partition menu opens.
9. Select "Exit and Shutdown" with the cursor keys.
10. Exit the menu and shut down the R&S UPP by clicking on the ENTER key.

3 Getting Started

3.1 Introduction - Getting Started

This chapter describes the manual operation of the R&S UPP audio analyzer. The information in this chapter also largely applies to the instrument designed primarily for use in systems provided that an external monitor, keyboard and mouse are connected to the instrument. More detailed information on the operation via external keyboard and mouse are explained in the chapter 4, "Manual Operation", on page 100.

The R&S UPP audio analyzer is able to perform virtually all measurements occurring in the audio world, from frequency response measurements through distortion factor and spectral displays to the analysis of digital data streams. Several measurement functions can be carried out and displayed at the same time, whereby the measurements are performed perfectly simultaneously at all switched-on channels.

The R&S UPP performs all measurements using digital signal processing. Here, analog signals to be measured are first subjected to complex preprocessing on analog measurement modules before they are digitalized and fed to the digital measurement routines.

This concept offers numerous advantages, for example:

- The measurement methods at the analog and digital interfaces are identical.
- The measurement functions are available at both the analog and the digital interfaces.
- Operation at the analog and digital interfaces is the same.

The many available options mean that the R&S UPP can be adapted to perform a wide variety of different tasks. The basic version of the instrument has analog audio interfaces. A number of special measurement functions are also available, but only after the appropriate options have been installed (see the data sheet for details).

This chapter, "Getting Started", only describes the functions available in the basic version of the R&S UPP audio analyzer.

3.2 Important Information for Measurements

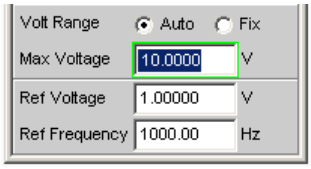
3.2.1 Maximum Output Voltage of the R&S UPP Generator

NOTICE

Possible Damage or Destruction of Input Circuits

The generator of the audio analyzer can generate analog output voltages with an RMS of up to 14 V. These levels can damage or even destroy sensitive input circuits.

There is an option in the "Generator Config" panel for limiting the analog output voltage. For measurements on sensitive circuits, it is advisable to set an appropriately low value in the "Max Voltage" field; this value then applies to all analog output signals, irrespective of the signal shape.



The pulse level of the digital audio signals can be up to 8.5 V. Although the risk of destruction is generally much smaller than for analog circuits, care must still be taken when making settings for activating digital circuits.

3.2.2 Avoiding Hum Loops

It is generally known in audio engineering that analog circuits must always be set up in such a way that hum signal pick-up is avoided. For this reason, it is important that a ground connection (grounding contact) be provided at only one point in the entire circuit.

Generator:

Pin 1 is not connected at the XLR connector. Symmetric (Bal) and asymmetric (Unbal) output are electronically floating (exception: Bal with switched-on output divider!). The output can be placed on ground (grounding it) by connecting Pin 3 to the ground.

Analyzer:

Starting with serial numbers 120100, 140100, 180100, Pin 1 is connected to ground via a capacitor, thereby connecting the pin with instrument ground only in relation to HF. This avoids formation of hum loops if the external connection connects pin 1 and 3 with each other.

To prevent any additional inadvertent ground connection being established via the generator, it is designed as electronically floating (exception: balanced operation with switched-on output divider). Pin 1 of the XLR connector is not connected. To prevent establishing any additional inadvertent ground connection via the audio analyzer when connecting the test setup with the analyzer inputs, Pin 1 of the XLR cable must not be connected with ground of the test setup (applies only to instruments with serial numbers lower than 1x0100, x = 2, 4, 8).

There are, however, some applications where the audio circuit to be tested is set up without any ground connection at all. It may be necessary to create a defined ground connection especially if hum pick-up is suspected. When connecting the UPP analyzer

with the test setup via a standard XLR cable, it is grounded via the analyzer inputs if Pin 1 of the cable is connected with ground of the test setup.

3.2.3 Help System

The audio analyzer has a context-sensitive help system.

If you have a question while operating the instrument, pressing the F1 key on the external keyboard opens a help page containing information on the currently highlighted parameter field.

From here it is possible to move to other help pages using the contents list, the index, scroll arrows and page-internal links. For more detailed information about help, see chapter 4.14, "Help System", on page 166.

3.3 Brief Introduction to Operation

3.3.1 Windows User Interface and Controls

To provide the user with a familiar environment, the operation of R&S UPP is largely based on the Windows user interfaces. All panels, entry windows, etc. are made up of known elements.

Operation follows the same basic rules which apply to other Windows programs in use today. It is assumed that the user is familiar with these basic rules. This information is therefore not given in detail in this manual.

The R&S UPP can be operated manually, provided that an external monitor, an external keyboard and a mouse are connected.

After being switched on, the instrument is in the same state as it was before it was switched off. This applies to all setting parameters of the R&S UPP, including those not currently displayed on the screen.

A mouse is used to operate the panels, the menu bar, the keys of the toolbar and the softkeys (changing functions depending on the application) on the external monitor.

Selection frames or the highlighting of an entry field (dark background) indicate the current entry focus. Entries can be made in the element with entry focus.

3.3.2 The Display

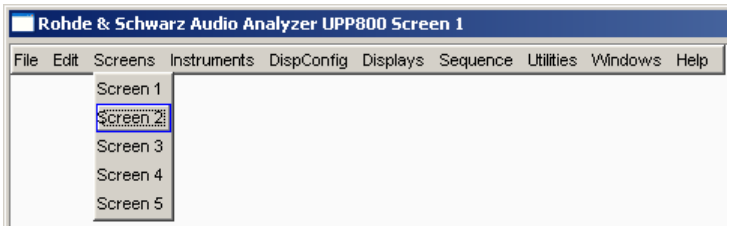
The display is the central element for manually operating the R&S UPP. Both the instrument settings in the various panels, and the measurement results are displayed here.

To make the various functions of the R&S UPP audio analyzer easier to operate, they are organized in a series of panels. The measurement results can be displayed as digi-

tal numeric values, data lists, in analog bar graphs or in result graphics. The user can freely choose the number of panels and the number of graphical windows to be shown in the display. The size of the windows can be changed within broad limits, whereby the font size, scaling and so on are adapted automatically (depending on the selected window).

Panels and display windows can be activated via the menu bar. The vertical menu bar opens by right-clicking in a white area (i.e. in an area that is not covered by panels or graphics). The horizontal menu bar opens if the mouse pointer is moved to the left edge of the R&S UPP application.

Five display windows (or "screens") are provided so that the wealth of information can be better organized; these windows can be selected via the menu bar.


Rohde & Schwarz Audio Analyzer UPP800 Screen 1
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Screen 1
Screen 2
Screen 3
Screen 4
Screen 5

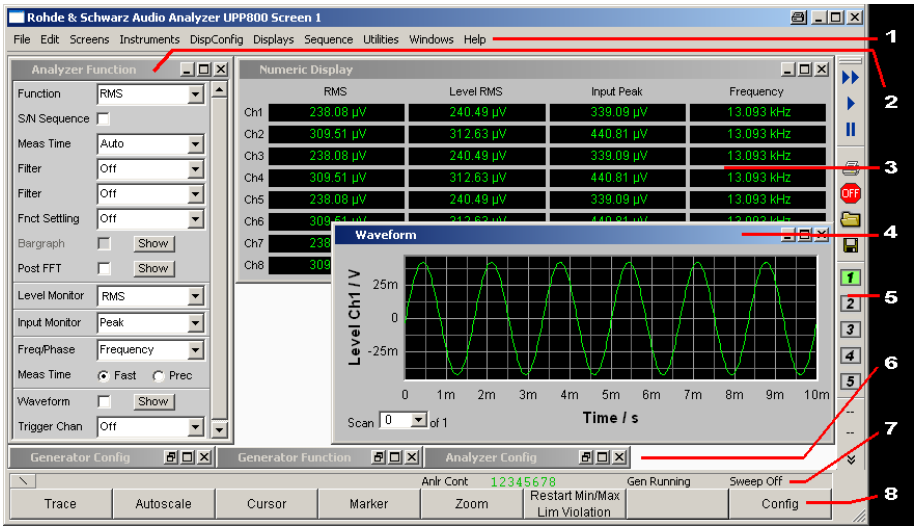


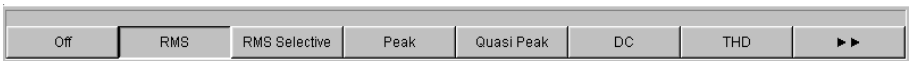
Fig. 3-1: Screen with the essential elements

1 = Menu bar
2 = Panel
3 = Numeric display
4 = Graphical window
5 = Toolbar
6 = Reduced panels
7 = Status bar
8 = Softkey bar or WINBAR

The softkey bar is always shown at the bottom edge of the window.

In normal operating mode, the softkey bar is visible; it contains eight buttons which are assigned the functions available in the selection windows of the panels.

If there are more than 8 elements to choose from, the hidden elements in the selection list can be displayed by pressing the last softkey containing the >> symbol or the first softkey containing the << symbol.



3.3.3 Panels and Display Windows

The R&S UPP audio analyzer distinguishes between the following panels and display windows:

- **Control panels** used to perform function settings.
- **Configuration panels** used for configuring how the measured values are to be displayed.
- **Numeric display fields** for displaying the measured values of the various measurement functions.
- **Combo displays** in which numeric measured values can be supplemented by bar graphs and limit monitoring.
- **Graphical windows** in which measured values are displayed in the form of diagrams.
- **Measured value lists** in which the measured values are listed in tabular form.

Panels are moved to the currently visible screen by activating the menu bar, moving the mouse onto "Instruments" or "DispConfig" and clicking in the desired panel in the pulldown menu that opens.

Display windows are selected in the same way, except that they are listed under the "Displays" menu item.

Each panel and display window is a separate window which can be either closed, opened or hidden. Panels / display windows are open if they are displayed on the currently visible screen. If the window is minimized and moved to the bottom of the screen, it is referred to as being "hidden".

As soon as a panel/display window can be operated, it can be moved on the screen and adjusted in size:

Grab the panel at the title bar with the mouse and move it. The size of the panels can be changed by grabbing the edges or corners of the panels with the mouse and moving them.

The same panel / display window can be displayed in several screens at the same time. The display characteristics can be different for each of the screens; the content is, however, always the same.

3.3.4 Structure of the Panels and Display Windows

The R&S UPP audio analyzer features the following panels with their main settings (for a detailed list of all panels with the most important setting parameters, see chapter 4, "Manual Operation", on page 100).

Panels which can be selected via the "Instruments" menu bar button:

Generator Config	• Selection of instrument (analog or digital interfaces) • Configuration of channels and bandwidths • Reference values
Generator Function	• Selection of test signals • Sweep function • Frequency and level settings • Filter and equalizer • DC Offset
Analyzer Config	• Selection of instrument (analog or digital interfaces) • Configuration of channels, measuring bandwidth and pre-filter • Range configuration • Reference values • Start and trigger conditions
Analyzer Function	• Selection of measurement functions • Measurement speed and accuracy • Activation of filter and equalizer • Activation of Post FFT • Selection and settings for level monitor • Selection and settings for input monitor • Selection and settings for frequency, phase, group delay measurement • Selection and settings for waveform monitor
Filter	• Definition of filter properties
Auxiliaries	• Settings for the audio monitor
Switcher Panel	• Operation of one or more R&S UPZ audio switchers
Protocol Generator	• Settings for the R&S UPP K21 digital audio protocol

Panels which can be selected via the "DispConfig" menu bar button:

Function Config Level Monitor Config Input Config Freq Phase Config	These four panels contain settings for displaying measured values • in the numeric display fields • in the associated combo displays • and settings for limits, minimum values and maximum values
Sweep Graph Config FFT Graph Config Waveform Config Bar Graph Config	Up to four of each of these panels are available; they contain settings for displaying measured values in the graphical windows, e.g. • One or two-channel display • Units, scaling, grid lines, etc. • Evaluation of minimum and maximum values • Entry of limit curves • Settings for cursors and markers

The measurement results of the audio analyzer are shown in the following display windows (for a detailed list of all panels with the most important setting parameters, see chapter 4, "Manual Operation", on page 100).

Except for the Dig Analyzer Protocol window, the panels can be selected via the "Displays" button in the menu bar:

Numeric Display	• Display of measurement results for measurement function selected in Analyzer Function panel • Display of measurement results for level monitor and/or input monitor selected in Analyzer Function panel • Frequency measurement results, or frequency measurement result and phase / group delay measurement result
Funct Ch1 to 2 Lev Mon Ch1 to Ch2 Input Ch1 to Ch2 Freq Ch1 Freq / Phase	These combo displays are extensions to the numeric measurement displays; they show the respective numeric value plus the following additional features: • Analog bar graphs • Limits • Minimum and maximum values
Sweep Graph 1 to 4 FFT Graph 1 to 2 Waveform Bar Graph 1 to 2	• Up to four of each of these display windows can be opened (depending on the window type) in order to display the scans of the different measurements • Graphical display shows one or two channels • The measurement results are displayed in the way defined in the associated configuration panel
Dig Analyzer Protocol	• The analyzed data of the digital audio protocol is displayed here (R&S UPP K21 option (digital audio protocol))

3.3.5 Basic Rules of Operation

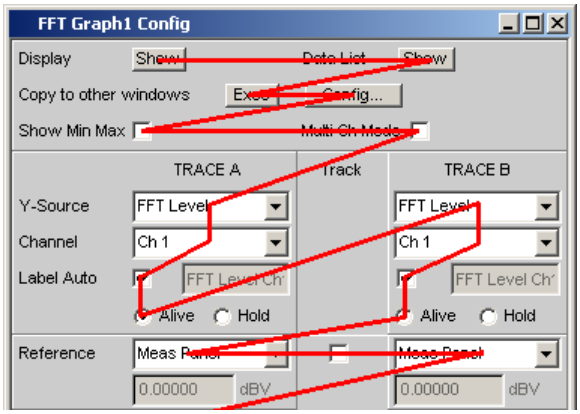
The following basic rules are intended to simplify operation of the audio analyzer:

- **Operating sequence in the panels from top to bottom**
  Changes to parameters of individual menu items may affect the selection or value range of menu items which are usually located further down (they affect the selection or value range in fields located higher up in only a few exceptional cases).
- **Sequence Generator – Analyzer – Measured value display**
  Many setting parameters can be copied to other panels. For example, the sweep frequency settings can automatically be adopted as the scaling for the graph.

3.3.6 Function Selection and Value Entry

All functions and parameters are set in the panels.

Besides the mouse, the up/down cursor keys of the external keyboard can also be used for navigating.



Panels can only be operated if they have the focus (indicated by the blue title bar).

Changing from one panel to another is done by clicking on the title bar.

Before settings can be made in a panel, the relevant parameter field must be highlighted, i.e. it must have the focus. This is indicated by a selection frame around the entry field.

The settings are made in the following ways:

Highlighting Controls

Click on the control with the mouse. The entry focus is indicated by a blue, green or magenta border.

Activating/deactivating functions

A checkbox is used to activate or deactivate functions. If the checkbox is active, the assigned setting is selected or enabled.

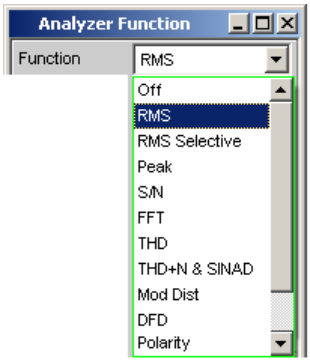
Toggling Functions

Radio buttons are used for functions which can be toggled between two settings. A black dot in the appropriate button indicates the selected status.

Only one of the two options can be active at any one time.

Selecting Parameter

Clicking on the button next to the current selection displays a selection field. The fold-down parameter list is displayed below the selection field.



The selection is made by clicking on the desired entry.

The parameter list can be exited without adopting the selected parameter by clicking in any area of the screen or with the ESC key of the external keyboard.

If the list is longer than the display, it is indicated by a scrollbar which can be grabbed and moved with the mouse.

Alternatively, parameters can also be selected using the softkeys.

The contents of the parameter lists are not fixed but vary depending on other settings selected.

Entering a Numeric Value

Numeric values can be entered or edited in these fields.

The following always applies: Entries outside the possible value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.

Edit mode:

When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame. The new value is entered via the external keyboard.

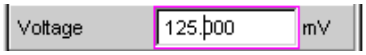
The numeric entry field is closed with:

- ENTER on the external keyboard or clicking in another panel area adopts the newly entered value.
- Pressing ESC on the external keyboard retains the old value.
- Softkeys – The selected unit is set and adopted together with the newly entered value.

The entered value is set in the hardware as soon as the numeric entry field is closed.

Direct mode:

It is also possible to enter the value in Direct mode. Changing to Direct mode is performed by pressing the ENTER key of the external keyboard; the color of the selection frame then changes to magenta.

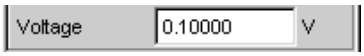


A digit can now be entered using the external keyboard; the digit at the cursor position is replaced.

In Direct mode, every setting change is immediately passed on to the hardware and executed. Direct mode can be exited using the ENTER or ESC key on the external keyboard.

Entering/Changing the Unit of a Value

The unit of a numeric value is displayed next to the entry field.



When the value is entered, all units available for the respective function are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey.

This is done differently depending on the selected mode:

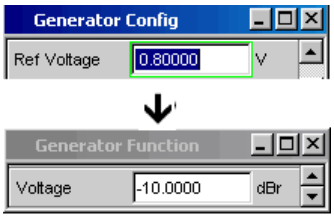
- In Edit mode, the newly entered numeric value is adopted and set together with the selected unit.
- In Direct mode, the physical value (number with the previously selected unit) is converted to the newly selected unit and adopted as the new numeric value.

Information on Using Reference Values

The audio analyzer allows reference values to be used when entering various values. These reference values are used as a basis for settings for other parameters.

The example below explains these interdependencies:

A reference voltage ("Ref Voltage") can be set in the "Generator Config" panel. The actual output voltage is set in the "Generator Function" panel where the unit is dBr, i.e. it is possible to enter the output voltage in dB relative to this reference value.



Entering Alphanumeric Values

When the focus is moved to a text entry field, the system enters Edit mode, which is indicated by a green selection frame.

If the complete text (e.g. for graph labels) is to be newly entered, simply begin entering characters using the external keyboard; the old text is deleted automatically when the first key is pressed.

The backspace/delete key can be used during the entry to delete the character to the left/right of the cursor.

The text entry field is closed with:

- ENTER – The newly entered text is adopted
- ESC – The old text is retained.

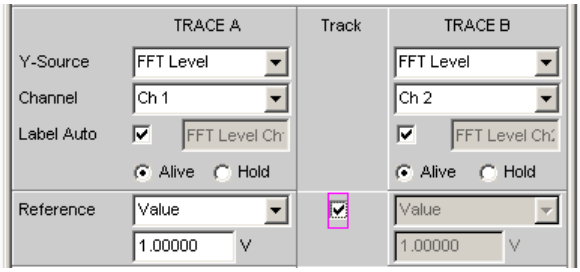
Display Fields

Sometimes it is very useful for operators to receive additional information about their settings.

Display fields inside the panels are used in such cases. These fields are shown in gray and cannot be accessed. They always contain valid values and therefore always show settings active in the background; the fields are updated as soon as a setting in the associated parameter field is changed.

Adopting Parameters

In many cases, settings are to apply e.g. to both measurement channels or to both traces. Here the R&S UPP provides multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time.



If the track box is activated, all of the settings within the function group apply to both columns. All fields with transferred settings in the right-hand column are shown as display fields. They appear gray and cannot be accessed while the track function is active. If a setting is changed in the associated parameter field in the left-hand column, this change is also shown in the display field in the right-hand column.

3.3.7 Input Help

Information on the possible entries is given at the bottom of the screen above the softkey bar. The units offered in the softkey bar and the limits specified in the "Valid Range" field always refer to the highlighted parameter field. The valid value range is given in the unit currently selected.

Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

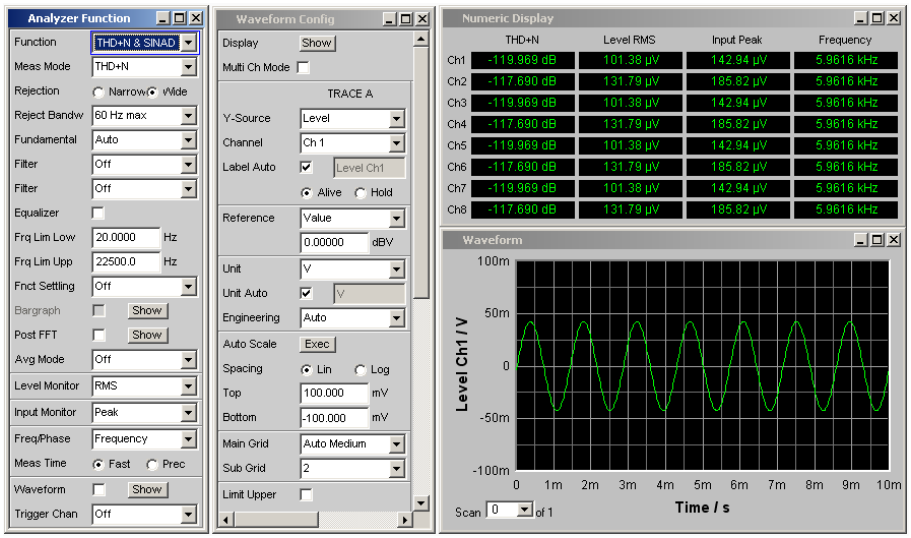
The specified ranges for value entries always take the current status of the instrument into consideration. They are therefore not constant and depend on the presets already configured for other parameters.

Below is an example for entering the generator output voltage; additional units can be displayed using the >> button:

3.3.8 Measurement Functions and Displaying Measurement Results

The audio analyzer offers various types of measurement windows for displaying the results of the numerous measurement functions. The measurement results can be displayed as digital numeric values, in analog bar graphs, in result graphics or in data lists. The user can open any number of measurement windows on the screen.

- **What** (which measurement function) is measured and **how** (which measurement method) measurement is performed, is preset in the "Analyzer Function" panel.
- The **configuration panels for measured value display** are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc.). A series of panels for the different measurement windows are provided for this purpose.
- The results are finally displayed in the various **measurement windows**.

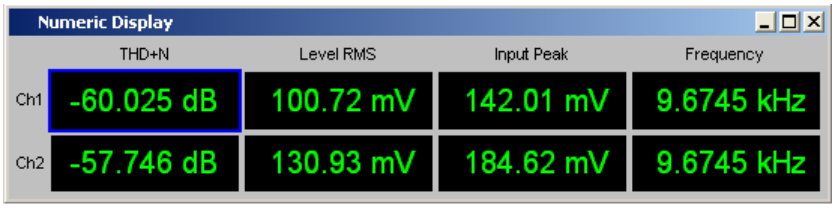


3.3.8.1 Numeric Display Field

The numeric display field provides a clear overview of the numeric values from various analyzer functions and displays a maximum of 8 numeric value results from the "Ana-

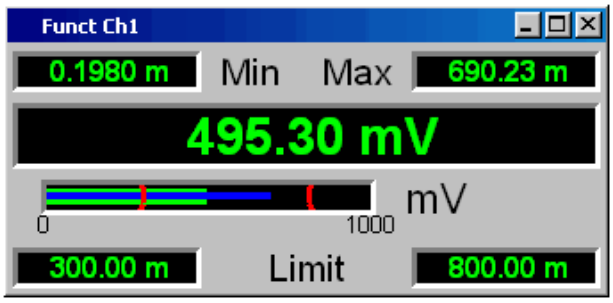
lyzer Function" panel. The individual columns are permanently assigned, from left to right:

- Column 1:
  Measurement results of the function that is set in the "Analyzer Function" panel in the "Function" line.
- Column 2:
  Measurement results for the set "Level Monitor" function.
- Column 3: Measurement results for the "Input Peak" function.
- Column 4:
  Display of either the frequency measurement result or, if "Freq & Phase" or "Freq & GrpDel" is set, display of the frequency measurement result in the first row and display of the phase or group delay measurement in the second row.



Combo Display

The combo display is used if the numeric value of a measurement result is to be supplemented by analog bar graphs, limit monitoring or the storage of maximum and minimum values.



The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the screen from a relatively long distance.

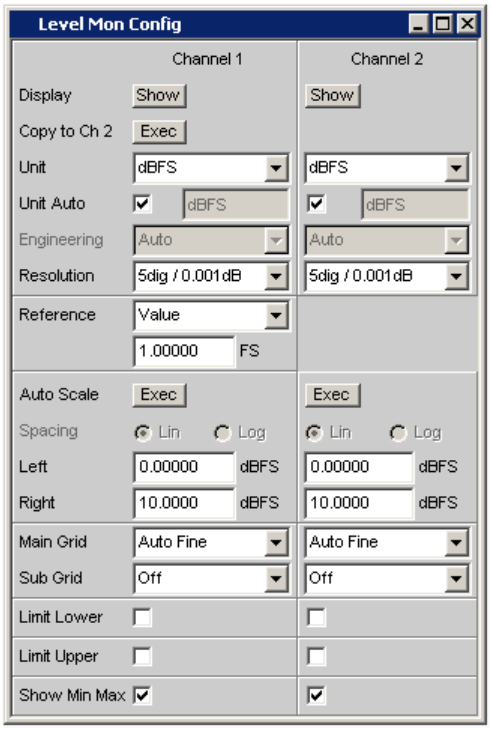
The easiest way to open combo displays is by double-clicking on the corresponding measurement display in the numeric display field.

Configuring the Numeric Display Field and Combo Display

The settings for the individual columns of the numeric display field or for the combo displays are made in the following four configuration panels which can be opened using the "DispConfig" button in the menu bar:

- "Funct Config"
- "Lev Mon Config"

- "Input Config"
- "Freq / Phase Config"



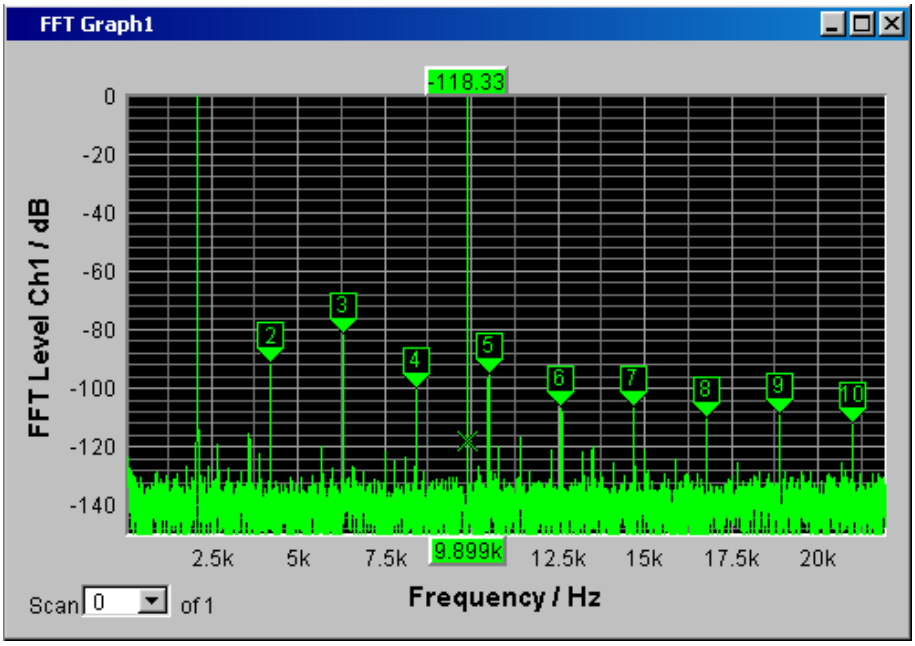
Graphical Window

The most informative way of displaying measurement results is to use a two-dimensional graph. The audio analyzer makes a distinction between the following graphical windows:

- Sweep Graph
- FFT Graph
- Waveform
- Bar Graph

These windows can be set using the associated configuration panels.

All graphical displays can be evaluated using horizontal and vertical cursors; markers are used to identify important measurement points. A broad range of softkey control functions can be used to scale graphs, to display sections of graphs, and to perform many other tasks.



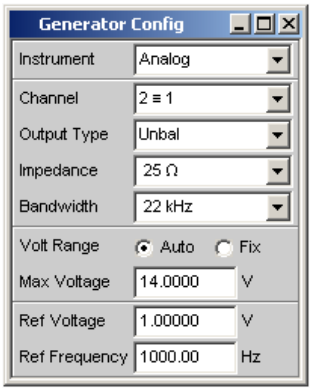
3.4 Introduction to Instrument Operation Using Examples

3.4.1 Measuring the Frequency Response of an Amplifier, Equalizer, etc.

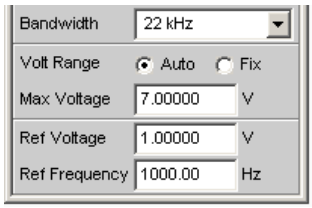
This example is based on the factory settings of the audio analyzer. It explains the changes made in the individual panels to set up the measurement and describes how to graphically display the measurement results. Finally, the example shows how to save the defined measurement setup so that it can be used again for other applications.

1. Step: Loading the factory settings
   The easiest way to load the factory setting of the instrument is by opening the menu bar with the mouse and clicking on File, followed by Preset (Load Default).
2. Step: Setting the required generator signal

a) The basic settings for configuring the generator are made in the "Generator Config" panel.
The frequency response is usually measured on both channels; this is already configured in the "Channel" field.
Depending on the device under test, the "Output Type" field allows switching over to symmetric wiring with the optional output impedance of 25 Ω or 600 Ω starting with serial numbers 120100, 140100, 180100.
If needed, click on the corresponding parameter field and perform the desired selection.



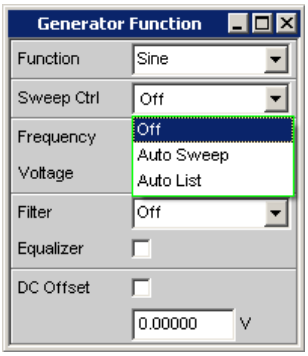
b) A maximum signal frequency of 22 kHz is generally the correct setting here.
The other following settings are also suitable for the majority of applications and do not have to be adjusted unless necessary.
This completes the settings in the "Generator Config" panel.



This completes the settings in the "Generator Config" panel.

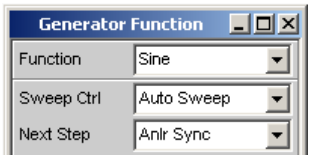
c) Next, the "Generator Function" panel is activated using the mouse.
Sine-wave signals are required; this setting is already selected.
To be able to measure the frequency response, the sine-wave signal must be swept in the frequency. A fixed frequency of "1 kHz" is preset in the default instrument setup.
To activate the sweep, select the "Sweep Ctrl" line, open the parameter list and selected the desired setting.

d)

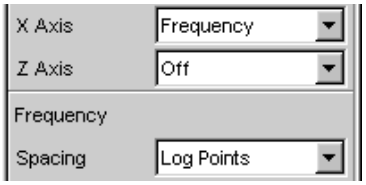


The parameter list closes and a number of additional fields appear in which further sweep parameters can be set.

e) The "Next Step" field remains set to "Anlr Sync". This setting causes the next sweep step to be triggered as soon as a valid measurement result is available in the analyzer part. This synchronization optimizes the sweep speed.

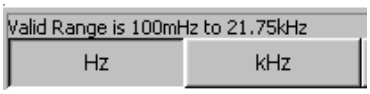


f) The sweep variable must now be specified in the "x-axis" field. Frequency is already preset here (as required in this example).
No other sweep variable is required; therefore, the "z-axis" field also remains unchanged and set to "Off".
The "Spacing" selection field is used to select the algorithm for advancing through the sweep points. This can be done using a linear or logarithmic step size; the number of individual sweep points ("Points") or the step size from point to point ("Steps") can be set.
This selection field is factory-set to "Log Points"; this is the usual setting for frequency response measurements.



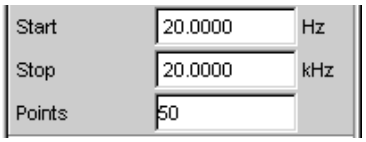
g) The values for the start and stop frequency of the sweep must be entered in the two fields "Start" and "Stop".
Highlighting the desired field gives it the green selection frame. The desired frequency value can now be entered directly (here: 20 Hz). Pressing the ENTER key adopts the value and adjusts the hardware accordingly.

The possible value range is given above the softkey bar. Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

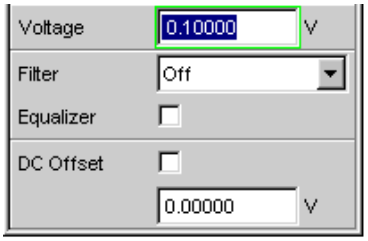


As soon as the value entry field is highlighted, all available units are displayed on the softkey bar; additional hidden units can be shown using the >> button. Value entry can be completed by actuating the softkey labeled with the desired unit; this is a particularly useful feature if a value is to be changed to a different unit.
The value for the stop frequency is entered in the same way (here 20 kHz).

h) The number of desired sweep points must be entered in the "Points" field, 30 points are preset here. Up to 1024 points can be selected (50 points are entered in this example). This generally provides an adequate number of measured values without making the overall measurement cycle too long.

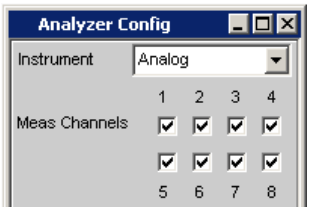


i) The desired output voltage for the measurement is entered in the "Voltage" field; this is again done by entering the value after highlighting the field. The value range is again displayed above the softkeys and the available units are shown in the softkeys.
The remaining fields are not relevant for this example. Configuration of the generator is therefore complete.

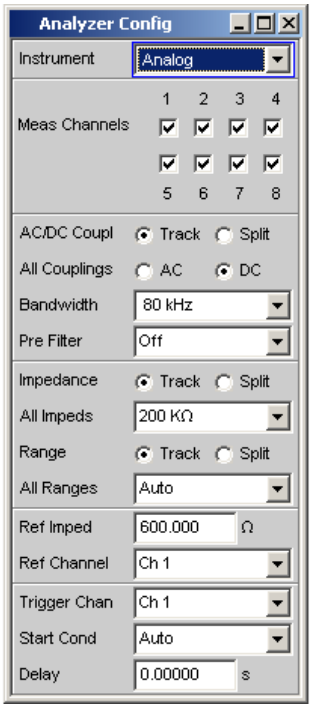


3. Step: Selection of required measurement

a) The basic settings for configuring the analyzer are again made in the "Analyzer Config" panel.
In order to operate the panel it must be selected and have the focus.
The frequency response is usually measured on all channels; this is already configured in the Meas Channel field. The following parameter fields occur only once and are set to "Track" and affect all channels.



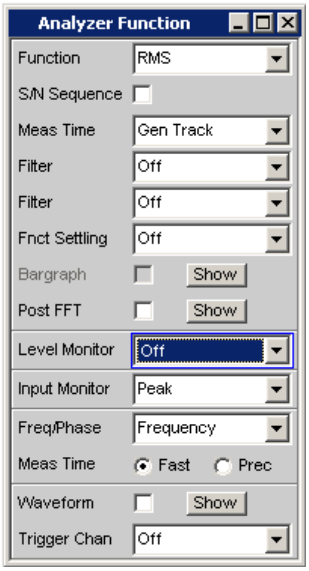
b) The "AC/DC Coupl" parameter field is set to "Track", i.e. AC and DC coupling can be switched as necessary for all channels using the two radio buttons. If the coupling is to be set individually for each channel, then the AC/DC Coupl parameter field must be set to Split.
The fields for the measurement bandwidth are already preset with the appropriate setting; no prefilter is required here.
The signal to be measured is fed via the symmetrical input sockets.
The auto-range function for all channels ("Range = Track") is generally the correct setting here. If range is to be set individually for each channel, then the "Range" parameter field must be set to "Split".
The default settings in the following fields are also correct.
This completes the settings in the "Analyzer Config" panel.



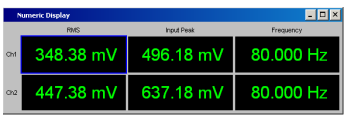
c) The following are set in the Analyzer Function panel:

- **what** is measured (which measurement function) and
- **how** measurement is performed (which measurement method)

The RMS of the voltage must be measured for the frequency response measurement described here; the required setting ("RMS") is already preselected.
The measuring time for each individual measurement point is selected in the "Meas Time" field. The default instrument setting here is Auto which means that the measuring time is automatically adapted to the input frequency, i.e. the measurement cycle speeds up as the frequency increases. This setting can (with just a few exceptions) be used for the majority of applications.
If the integrated generator is used for measuring the frequency response (as in this example), the setting "Gen Track" should be used. The measurement time is then automatically adapted to the frequency generated in the generator. The frequency information from the generator is passed on directly to the analyzer. The analyzer then adjusts its measurement time to precisely one period (or to an integer multiple of one period). The advantage of this method is maximum measurement speed with maximum accuracy.
All other parameter fields are not relevant for this example; the settings in the "Analyzer Function" panel are therefore complete.

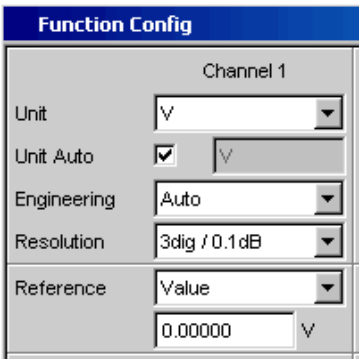


4. Step: Displaying the measurement results – Numeric measurement display
In the default instrument setup, the numeric measurement display is also already open. If the DUT is correctly connected to the audio analyzer, measured values will already be displayed.

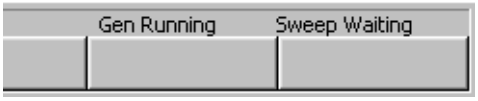


The panels for configuring the measured value display are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc.). A

series of panels for the different measurement windows are provided for this purpose.
The "Function Config" panel is shown here as an example; the first column of the numeric measurement display is configured in this panel, i.e. the display fields which show the measured level values for the frequency response measurement described here.
The unit for the numeric measured value displays is set in the Unit field.
The Engineering parameter is used to determine whether the display automatically toggles between µV, mV and V, for example, or whether other unit formats are desired.
If the measurement results are to be displayed as relative values, they are referred to the reference value set in the Reference field.
Other parameter fields in this panel are used to set limits and to display extreme values. These functions are described in detail in chapter 4, "Manual Operation", on page 100 and in chapter 5, "Instrument Function", on page 185.



5. Step: Starting the sweep
Although the analyzer is already supplying measurement results, the status message "Sweep Waiting" above the softkeys indicates that the sweep has not yet been started although it has been configured in the "Generator Function" panel.

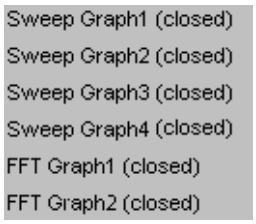


a) This is done with the "Start" button from the toolbar (the two double arrows) or the "Ctrl F5" key on the external keyboard. The status message "Sweep Run Cont" informs the user that when this key is pressed the sweep will start and be repeated continuously.
b) The "Stop/Cont" button of the toolbar (two vertical bars) or the "Ctrl F7" key of the external keyboard can be used to interrupt the sweep process at any time ("Sweep Stopped" status message), pressing the key again continues the process.
c) The "Single" button of the toolbar (single arrow) or "Ctrl F6" of the external keyboard can be used to start the sweep only **once**; after the sweep process is complete, the status bar indicates "Sweep Terminated".

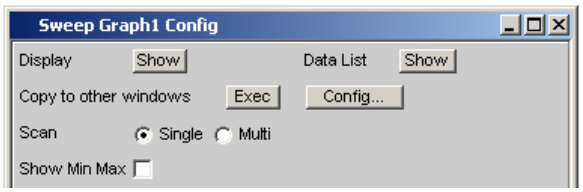
6. Step: Displaying the measurement results – Graphical windows

The results of a frequency response measurement are usually displayed graphically with the measured output voltage values of the DUT being plotted on the frequency axis.
The following settings are required for this:

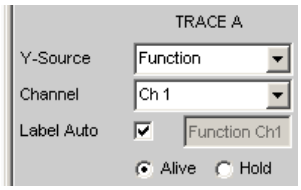
a) To avoid overloading screen 1 with too many panels, change to screen 5 to display the graphical representation.
b) Open the menu bar and, from the selection list under the "DispConfig" button, select the "Sweep Graph 1 Config" panel. As explained above, the way in which the measurement results are presented is determined in the configuration panels. Each graphical window has its own configuration panel. The "Sweep Graph 1 Config" panel required here has two columns, but only Trace A is shown to provide a better overview.



c) The associated graphical window can be opened using the "Show" button in the "Display" field. The window appears in the same screen so that the effect of the following settings can be observed directly.
In each graphical window, one or two traces (Trace A and Trace B) can be plotted on one x-axis. Each trace can consist of a large number of scans. In this example, only one single scan is to be displayed; the "Scan" field can therefore remain set to "Single".



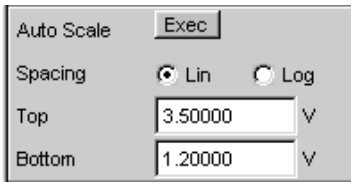
d) The scans can display the results of the different measurements available in the R&S UPP.
For the frequency response measurement, the measurement results for the measurement function selected in the Function field in the Analyzer Function panel (here the RMS measurement) must be displayed on a graph. For trace A, the Y source field is set to the **function** result and the measuring channel to be displayed is selected with the Channel = **Ch1** parameter field underneath it (this is already preset in the default setup).
The "Alive" setting means that the results are displayed continuously; the "Hold" setting "freezes" the traces.



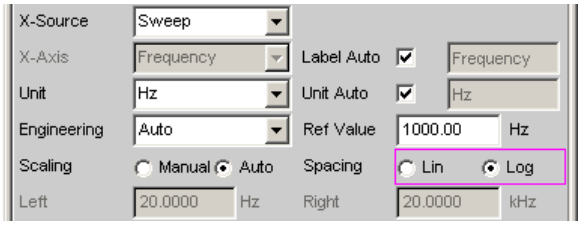
e) The units to be used for the measured values on the y-axis are set in the next section.
If the unit used in the numeric display window is also to be used in the graphical window, the "Unit Fnct Track" checkbox must be activated. If this is not the case, a unit can be selected from the parameter list next to the checkbox.
The "Engineering" parameter is used to determine whether the display automatically toggles between µV, mV and V, for example, or whether other unit formats are desired.

f) All the other default instrument settings are correct and allow a result to be displayed immediately in the form of a graph. If the sweep is started with the "Start" or "Single" button from the toolbar or "Ctrl F6" or "Ctrl F7" of the external keyboard, the scan appears in the graphical window.

g) The scaling will probably need to be adjusted. Actuating the "Exec" button in the line "Autoscale" rescales the graph on the basis of the measured minimum and maximum values so that the entire trace fits in the graphical window.
The end values for the y-axis can, however, also be entered in the two fields "Top" and "Bottom".

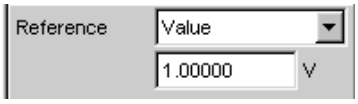


h) The default settings for the x-axis are also mostly correct for this example:
By selecting a frequency sweep in the Generator Function panel, the x-axis is automatically defined as the frequency axis with the unit Hz.
If "Auto" is set in the "Scaling" field, the start and stop frequency of the sweep defined in the "Generator Function" panel is automatically used as the upper and lower end value for the x-axis.
The "Lin" setting in the "Spacing" field is unsuitable for this example. Since a sweep with logarithmic step size has been selected for this measurement, the x-axis should also be subdivided logarithmically.

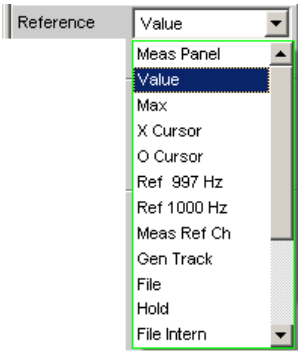


7. Step: Using a relative unit in the graphical window
The settings so far made allow the frequency response of the DUT to be displayed graphically but not in a way that conforms to standards.
In the case of frequency response measurement, the relevant standards stipulate that the deviations of the output voltage must be plotted over frequency, whereby the output voltage of the DUT at the reference frequency 1 kHz (for analog measurements) is used as the reference level.
The following settings in the "Sweep Graph 1 Config" panels are used to adapt the graph for this measurement example:

a) A default reference value of 1 V is set in the Reference field.

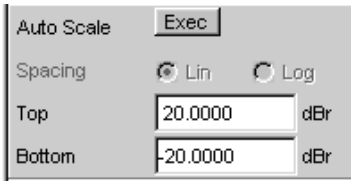


This value must be replaced by the output voltage value of the DUT measured with the reference frequency of 1 kHz.
Here, the R&S UPP offers a very elegant option:
If the parameter list is opened in the "Reference" field, it is possible to select the setting "Ref 1000 Hz". With this setting, the value measured at this frequency is determined (if necessary by means of interpolation between the measured values at the two adjacent frequencies) and used as the reference value.

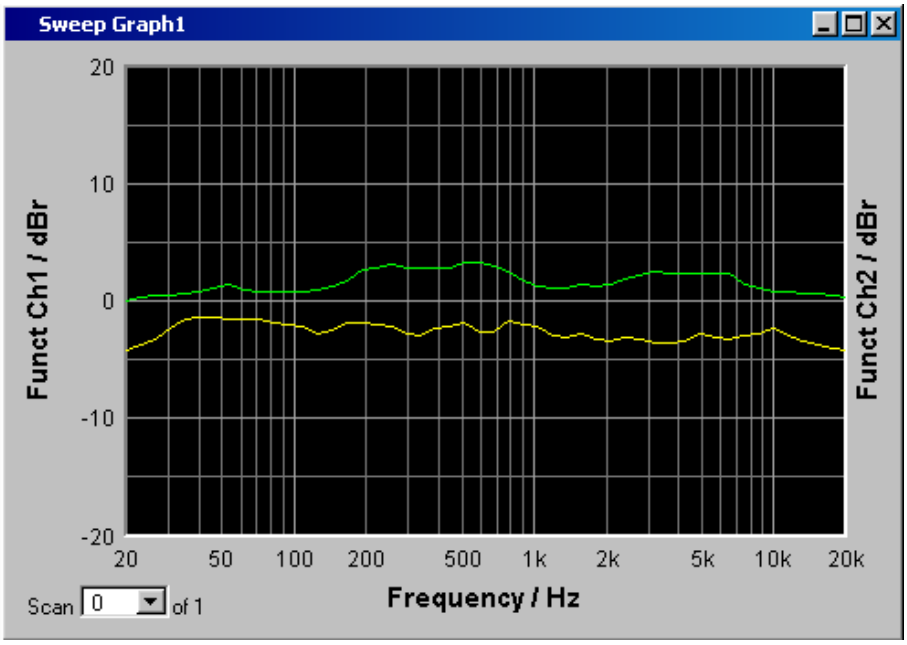


b) All that remains is to select the unit dBr in the "Unit Fnct Track" field. All measured values are then displayed in dB relative to the reference value selected above. This satisfies the standards defining frequency response measurement.

c) The y-axis must now be scaled according to requirement, e.g. from +20 dBr to –20 dBr.



d) If the measurement result of the second channel has been selected for Trace B, the graphical display for the measured frequency response of the DUT may look like the example shown below.



8. Step: Saving this device setting

   a) The menu bar, "File", "Save Setup as" opens a window for saving files.
   b) The desired file name can now be entered with the external keyboard. The file extension is assigned automatically once the file name has been entered (here .SET); it is advisable to use this automatic assignment function as it prevents entry errors.
   c) If this device setting is to be used again at a later time, simply open the menu bar and click on "File", "Load Setup" to be able to load this setup again in the File window.

3.4.2 Measuring Total Harmonic Distortion (THD+N) of a DUT

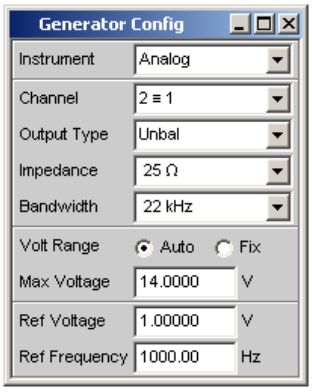
This example is also based on the factory settings of the audio analyzer. However, only the settings in the individual panels which differ from the settings in the previous example are explained.

1. Step: Loading the factory settings

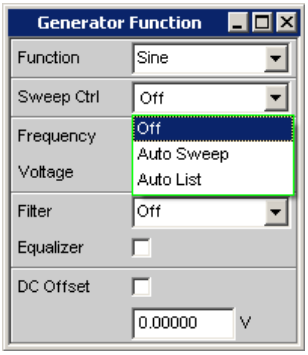
   a) Load the default setting by opening the menu bar and selecting "File", "Preset (Load Default)".

2. Step: Setting the required generator signal

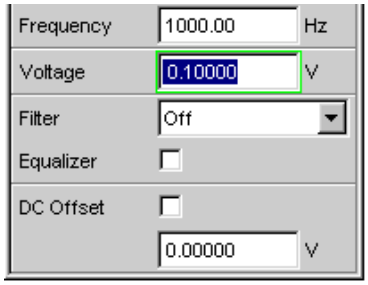
a) In the "Generator Config" panel, the basic settings for configuring the generator in this example are the same as those set for the frequency response measurement described in the previous section.
Depending on the DUT, "Output Type" may have to be switched to symmetric wiring.



b) Next, the "Generator Function" panel is activated.
Sine-wave signals are required. This setting is one of the presets.
The total harmonic distortion is often only specified for the reference frequency 1 kHz (for analog applications). Fixed frequencies are therefore used for measurement; as a result, "Sweep Ctrl" must remain set to Off.

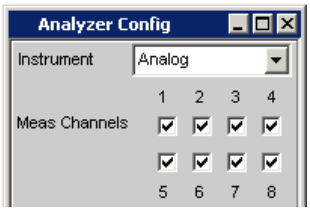


c) The frequency 1 kHz is already preset in the default instrument setup.
Only the output level required for the measurement may have to be adjusted (in the Voltage field).
The remaining fields are not relevant for this example. Configuration of the generator is therefore complete.

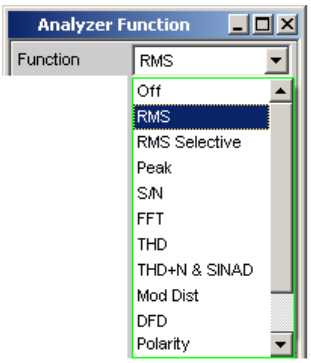


3. Step: Selection of required measurement

a) The basic settings for configuring the analyzer are again made in the "Analyzer Config" panel.
These settings are made in the same way as shown in the previous example.

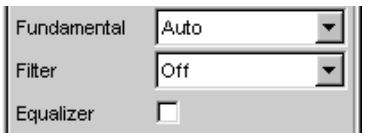


b) Next, the "Analyzer Function" panel is activated.
The measurement function and measurement method are set in this panel.
First, the measurement function is selected by unfolding the parameter list and selecting the THD+N & SINAD item.

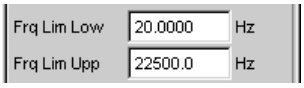


c) In the next field "Meas Mode", various modes for distortion factor measurement can be selected; the presetting "THD+N" is correct for this example.

d) With the THD+N measurement, the fundamental of the signal to be measured is suppressed using a notch filter. The audio analyzer can automatically determine the fundamental from the spectrum and adjust the notch filter to it ("Fundamental Auto").
Filter and Equalizer are only required in exceptional cases.



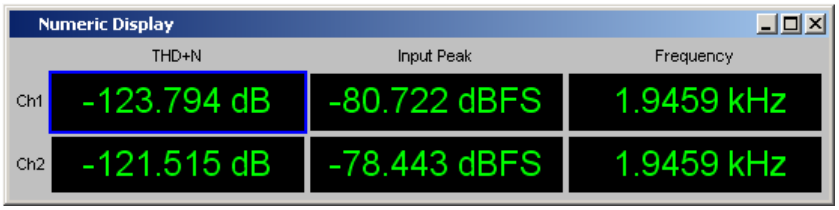
e) The calculation for harmonics and noise components can, if necessary, be restricted to within band limits which can be entered in the two fields "Freq Lim Low" and "Freq Lim Upp".



All other parameter fields are not relevant for this example; the settings in the "Analyzer Function panel" are therefore complete.

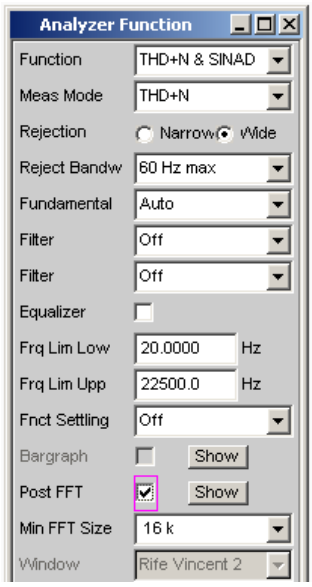
4. Step: Displaying the measurement results – Numeric measurement display

a) In the default instrument setup, the numeric measurement display is already open.
If the DUT is correctly connected to the audio analyzer, the measured values for the harmonic distortion can be read off in the first column.
In the default setup, THD+N values are given in dB; if a display in % is desired, this unit can be changed in the "Function Config" panel.



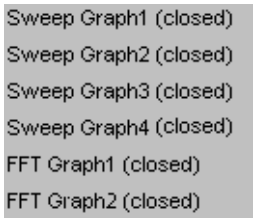
5. Step: Displaying the spectrum in the graphical window
Display of the numeric value alone is sufficient for the majority of harmonic distortion measurements. Here, however, the spectral composition of the output signal at the DUT is also to be analyzed.
With the audio analyzer, it is possible to follow up all distortion measurements with an FFT analysis.
The necessary settings for this are explained in the following section:

a) In the "Analyzer Function" panel already used for configuring the THD+N measurement, an FFT analysis to be performed following the measurement can be set after the actual measurement function has been selected.
To do this, highlight the "Post FFT" checkbox.
The size of the FFT can be adjusted if necessary.

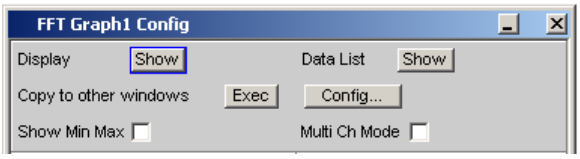


b) To graphically display the results of the FFT analysis, first change to screen 5, which is empty in the default setting.

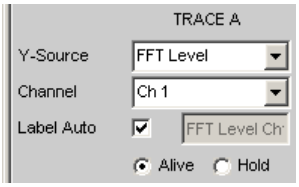
c) Open the menu bar and from the selection list under the "DispConfig" button, select the "FFT Graph 1 Config" panel.
As explained in the previous example, the way in which the measurement results are presented is determined in the **configuration panels**. Each graphical window has its own configuration panel.
The "FFT Graph 1 Config" panel required here has two columns; to simplify matters, only Trace A is shown in the example.



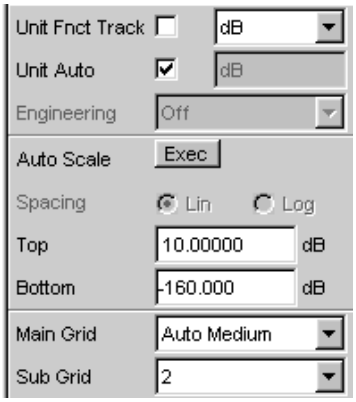
d) The associated graphical window can be opened by actuating the "Show" button in the "Display" field. The window appears in the same screen so that the effect of the following settings can be observed directly.



e) In each FFT window, one or two traces (Trace A and Trace B) can be plotted on the frequency axis.
In this example, the level measurement results of the FFT analysis are to be displayed on a graph. For Trace A, the "Source" field is therefore set to "FFT Level" and "Channel" to Ch1 (this is already preset in the default setup).
The "Alive" setting means that the results are displayed continuously; the "Hold" setting "freezes" the traces.



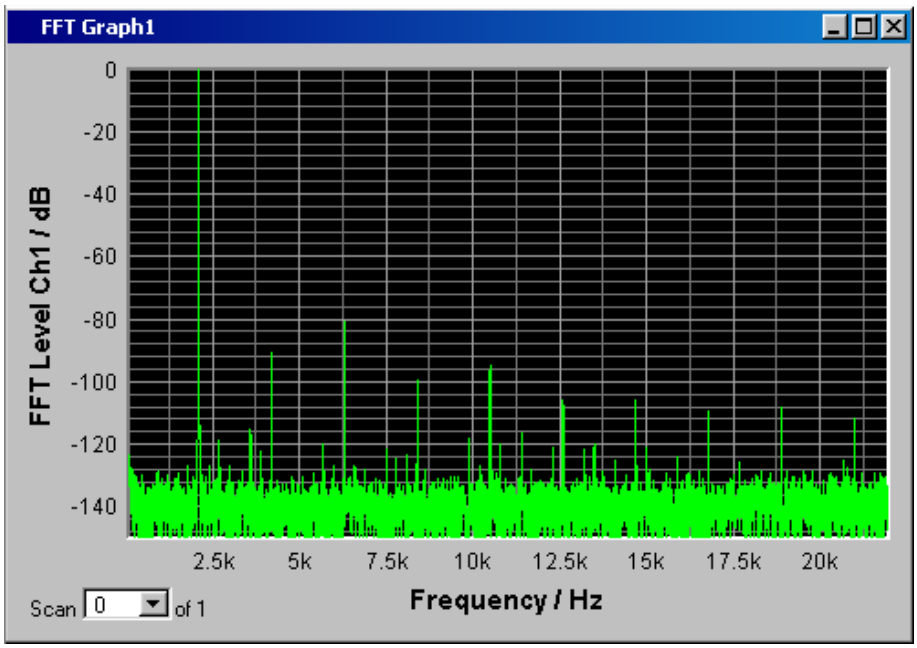
f) The settings for the unit, y-axis scaling and grid are already preset in the default setup; a result should therefore be visible. If necessary, these settings must be adjusted.



The settings for the x-axis are also mostly correct for this example; they were explained in the previous example.

g) In the "Analyzer Function" panel, you can also use the "Show" button to open the graphical window for Post FFT. However, this displays the window in the same screen, without opening the associated configuration panel.

h) The spectral display of the output signal with its harmonics may now look like the example shown below.



6. Step: Evaluating the graphic with cursors and markers
All graphical displays can be evaluated using horizontal and vertical cursors; the X and Y-values shown in the display fields associated with the cursors are always current values. Markers are used to identify important measurement points. The

cursors and markers can only be operated using the softkey bar; the required softkeys are displayed at the bottom of the screen as soon as the graphical window has the focus.
The softkeys are arranged in several levels; the lower levels are accessed by actuating the respective button. Actuating the "Back" button redisplays the higher level.

a) Setting markers:
Pressing the "Marker" button calls up the Marker softkeys which are used in this example to first select the Trace A scan so that markers can be set.

The next softkey level appears simultaneously:

The "Track to Max" button is used to set a marker at the maximum value of the curve, i.e. the fundamental in this example of THD+N measurement.
The "Harmonics" button is used to mark the harmonics of the fundamental indicated by the marker.
Pressing the "Back" button twice calls up the first softkey level again.

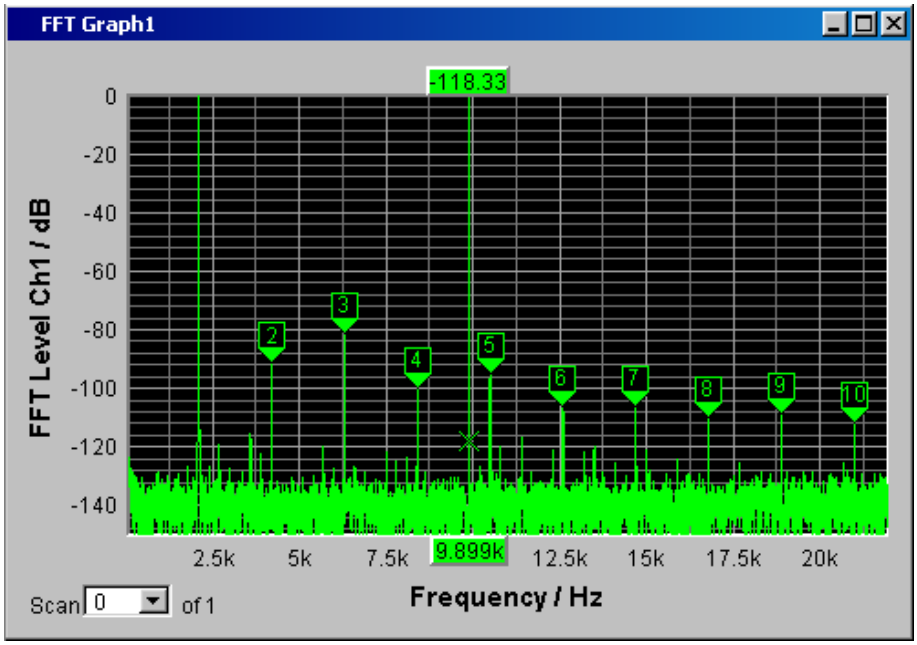
b) Using cursors:
Activating the "Cursor" button displays the cursor softkeys:

The audio analyzer uses two cursors which are identified by the symbols ○ and X. These symbols are used to mark the measured points in the graph (see the example graph below).
Only one cursor is active and can be moved in the graph at any one time. The active cursor is displayed with a solid line; the inactive cursor is displayed with a broken line.
With the ○ <--> X button, the ○ and X cursor are alternately switched on.
If, for example, the cursor was activated with the ○ cursor button, the following softkeys appear:

Activating the Vert A button activates a vertical cursor on Trace A; this cursor can then be grabbed and moved with the mouse.
The step size with which the cursor is being moved can be set via additional softkeys of the next level which are called with the "Movement" softkey.

The **Movement** button opens the next softkey level where various step sizes for moving the cursor are offered. The currently selected step size is indicated in brackets in the second label field of the "Movement" button.

c) With activated markers and a cursor, the graphical display of the output signal with its harmonics may look like the example shown below.



7. Step: Saving this device setting
This example can also be saved as an instrument setting. Saving is performed as described in the previous example.

3.5 Loading Predefined Instrument Setups

To make initial measurements easier for new users, example setups for the basic measurements required in audio engineering are supplied with every audio analyzer. These setups allow the instrument to be used almost immediately.

The setup files are available for the different domains (analog or digital) of the generator and analyzer. They are stored in the `AA, AD, DA, DD` subdirectories of the `D:\UPV\Setup Examples` directory; the generator domain is listed first followed by the analyzer domain. The file name indicates the respective application.

Many of these example measurements (essentially those at the analog interfaces) can be performed using the basic version of the audio analyzer. The R&S UPP B2 (digital audio interfaces) option is required for all measurements at the digital interfaces.

The predefined instrument settings can be loaded in the following way:

► Open the menu bar, move the mouse pointer to the "File" button and select the "Load Example Setup" entry from the opening listThe file window is opened displaying the directory in which the example measurements can be selected.

All of the setups listed here use the same basic settings.

Basic settings for analog inputs/outputs:

- All channels of the generator and analyzer are active; the unbalanced generator output signal with minimum output impedance and maximum analyzer input impedance are used.
- All inputs/outputs are floating; the auto-range function is activated.
- Frequency sweeps are usually performed logarithmically from 20 Hz to 20 kHz; the appropriate graphical windows are open on the screen; the x-axis is scaled automatically in the associated configuration panels; the y-axis is permanently set to standard values.
- Voltages are mostly given in volts; the generator output voltage is set to 0.1 V; distortion and intermodulation values are given in dB.

Basic settings for digital inputs/outputs:

- Both channels are active; the generator generates 24-bit words; the analyzer analyzes 24 audio bits. The sampling frequency is set to 48 kHz, the Professional format acc. to AES 3 is used. The digital pulse amplitude of the generator is 1 V at the BNC outputs, which corresponds to 4 V at the symmetric outputs.
- Levels are mostly given in dBFS; audio signals are usually generated at a level of –20 dBFS.

Users can, of course, adapt the used basic settings to their own specific measurement tasks at any time. To do this, the respective setup must be loaded and the appropriate changes are then made in the panels. The setup can then be saved again.

The application setups are also updated when new audio analyzer firmware is installed. Modified setups should therefore be saved under a different file name.

Users are also free to create new directories for their customized setups.

4 Manual Operation

4.1 Introduction - Manual Operation

The R&S UPP audio analyzer is available in three model variants that differ with respect to the number of analog analyzer channels: The R&S UPP can be ordered with 8 (R&S UPP800), 4 (R&S UPP400) or 2 (R&S UPP200) channels. All models are optimized for use in production with remote control interfaces and are offered without display, without front panel controls and without CD/DVD drive. To enable a convenient manual control, the instrument can be equipped with an external monitor, an external keyboard and a mouse. All models feature the same functions.

The R&S UPP audio analyzer uses the Windows® XP operating system. The instrument is therefore operated in largely the same way as other Windows® applications. All panels and display windows have the standard Windows® format and are operated in the same way. An external monitor, an external keyboard and/or mouse allow direct and convenient access to entries and settings. The clearly organized display shows the current state of the audio analyzer.

If the R&S UPP model is to be operated manually, you need to connect an external monitor, a mouse and a computer keyboard. In the "Overview of Keys" section at the end of this chapter, the keys or shortcuts on a computer keyboard and their function for the manual control are listed. For additional notes for the control via mouse and keyboard, see chapter 4.3.2, "Operation Using the Mouse", on page 108 and chapter 4.3.3, "Operation Using an External Computer Keyboard", on page 108.

The use of the toolbar simplifies the operation when using the mouse. See chapter 4.9, "Settings in the Menu Bar", on page 158.

Numerous online help functions assist the user in making settings.

After being switched on, the instrument is in the same state as it was before it was switched off. This applies to all setting parameters of the R&S UPP, including those not currently displayed on the screen.

The following chapter describes the manual operation of the R&S UPP audio analyzer. This includes a description of the screen displays, how to operate the panels and how to set parameters. Each of the setting descriptions is accompanied by a table explaining how the different functions are performed using an external computer keyboard or mouse.

An overview of the keys, panels and display windows can be found at the end of this chapter.

The functions of the R&S UPP audio analyzer are described in detail in chapter 5, "Instrument Function", on page 185. An explanation of the general operating concept and a brief introduction that contains step-by-step configurations for initial measurements is described in chapter 3, "Getting Started", on page 65. The remote control of

the instrument is described in chapter 6, "Remote Control - Fundamentals", on page 609 and chapter 7, "Remote Control - Command Description", on page 651.

4.2 Functional Division of the Audio Analyzer

4.2.1 Instrument Concept

The audio analyzer combines the following components in a single housing:

- Generators with analog and – with the R&S UPP B2 (digital audio interfaces) option – also digital audio interfaces for generating the multiple test signals,
- Analyzers with analog and – with the R&S UPP B2 – also digital audio interfaces for extensive measurement options and
- a computer (PC) with the Windows XP® operating system for controlling and operating the entire instrument and with connections for peripherals and LAN.

4.2.2 Generators

4.2.2.1 Universal Generator

The universal generator consists of an FPGA and generates various test signals, from sine-wave tones to intermodulation test signals (two-tone signals) to noise signals and multi-tones. Following appropriate conversion, these signal are made available at the analog outputs.

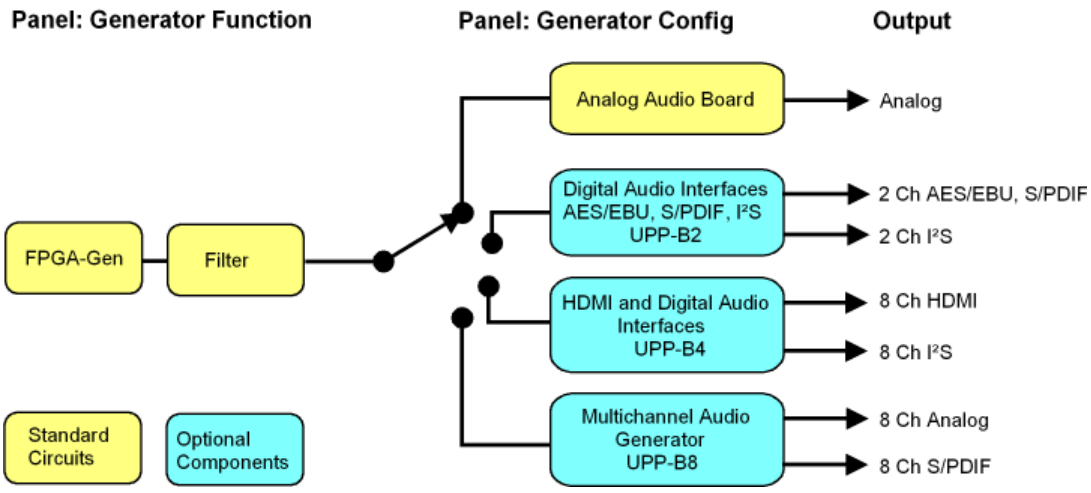
With the R&S UPP B2 (digital audio interfaces) option, they can also be output as digital data streams in various formats at AES/EBU and SPDIF interfaces and at optical interfaces.

The R&S UPP B4 option (HDMI and digital audio interfaces) allows channel status data to be generated in the data stream of the digital audio interface of the generator instruments "Digital Audio" and "HDMI".

All test signals can be output on both channels. However, different signals are also available at the digital outputs.

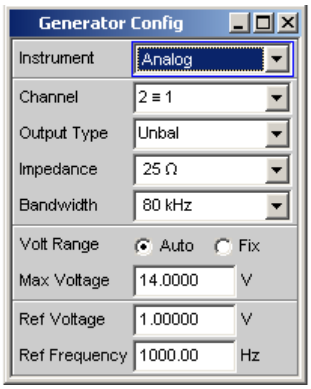
4.2.2.2 Function Blocks and Their Assignment to Control Panels

The diagram below shows the function blocks of the generators in the audio analyzer:

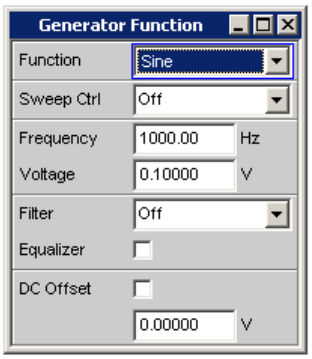


The generators of the R&S UPP are operated in two stages:

1. In the first step, the following settings are made in the "Generator Config" panel:
   - the audio interfaces at which the test signals are to be output
   - the channels which are to be active
   - maximum level and reference values
   - etc.



2. In the second step, the following settings are made in the Generator Function panel:
   - type of test signal
   - output level
   - frequencies
   - etc.



4.2.3 Analyzers

The R&S UPP performs all measurements using digital signal processing. Here, analog signals to be measured are first subjected to complex analog **preprocessing** on analog measurement modules before they are digitized and fed to the digital measurement routines.

This concept has the following advantages:

- All audio measurement functions are available at both the analog and the digital interfaces.
- The measurement methods at the analog and digital interfaces are identical.
- Operation at the analog and digital interfaces is always the same.
- The R&S UPP can also perform the complex measurement functions simultaneously on all channels; this results in an overall measuring time that is insignificantly higher than the sample time.
- Several measurement functions, e.g. level measurement, FFT analysis, waveform analysis, etc., are calculated simultaneously in FPGAs and can therefore be displayed at the same time without a delay.
- The digital measurement routines can continuously adapt their speed to the current input frequency and thus achieve high measurement speeds.
- Since the filters are also digital, an almost infinite number of filters is available and can also be used for measurements at analog interfaces.

With the R&S UPP B2 (digital audio interfaces) option, digital audio data streams can also be measured at AES/EBU or SPDIF interfaces.

4.2.3.1 Function Blocks and Measurement Levels

The analyzer component of R&S UPP contains a series of measurement options that are organized in various measurement levels. The measurement results of these levels can also be displayed simultaneously.

The unfiltered input signal is analyzed at the **input monitor level**. The peak level at the input connectors is analyzed here.

The pre-filter, which can be looped into the signal path before all other analyses, is located in front of the **level monitor**. Here you can analyze the RMS value, the peak value or the DC voltage component of the signal to be tested.

Following any additional filtering using one or two filters, detailed analysis is initiated at the **function level**. All the usual analysis tools for measuring linear and non-linear distortion, interference, etc., can be found here. The analysis in the time domain (waveform) as well as the FFT analysis with extreme dynamic response and frequency resolution take place here. Moreover, it is possible to record input signals to the hard disk in order to analyze them at some point later.

In the **Freq/phase level**, the measured values for **frequency** and **phase** or **group delay** can be displayed in a different measurement window parallel to the structure described above.

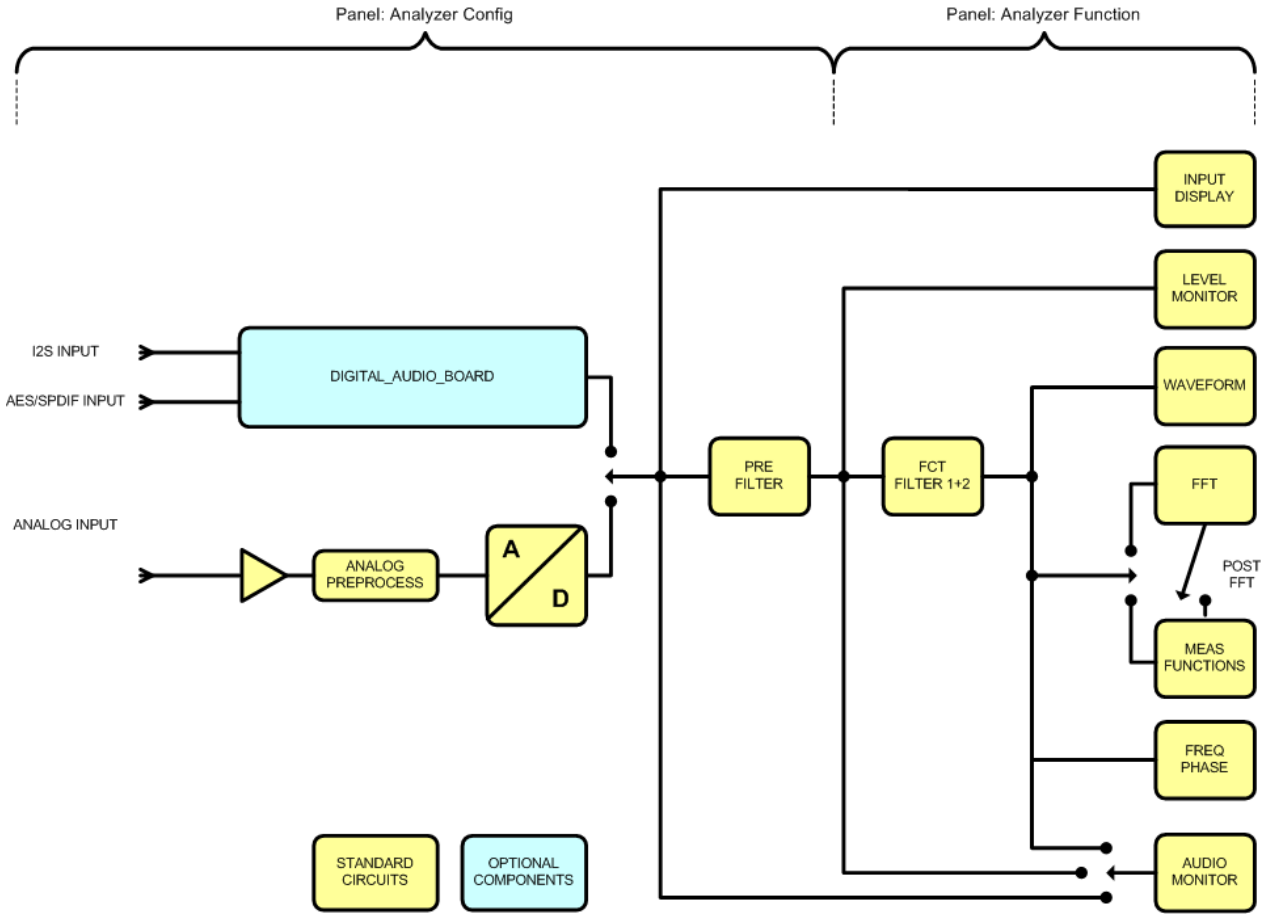
The monitor outputs at the rear side of R&S UPP allow an oscilloscope or external circuits to be connected, can be switched to the input-monitor level or function level and allow the control of analog or digital input signals as well the different analysis levels directly at the input.

With the R&S UPP B2 (digital audio interfaces) option, the digital ancillary data in a standard configuration, such as channel status data, validity and parity bits, can also be transmitted.

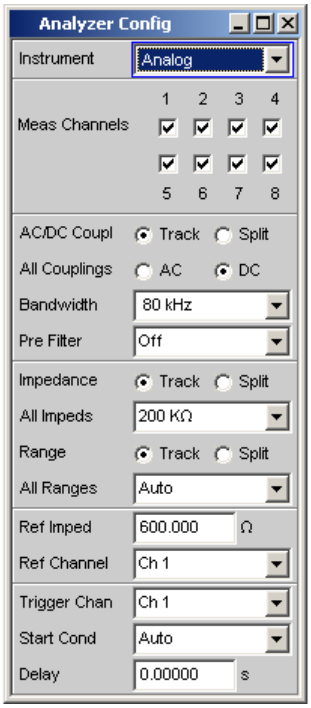
The results of these different measurement functions can be displayed in various ways in the **measurement windows**. The type of display, the units used, scaling, etc., can be set differently for each measurement function in the associated panels.

The diagram below shows the function blocks and the analysis levels of the R&S UPP:

Similar to the generator component, the analyzer component is operated in two stages:

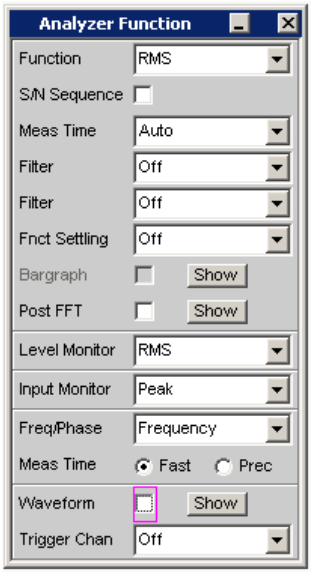


1. Operation begins in the "Analyzer Config" panel with the selection of:
   - analog or digital input connectors
   - number of channels
   - AC or DC coupling
   - IF bandwidth
   - and a number of other parameters

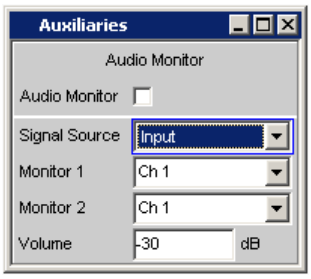


2. In the second step, the measurements are set at the various analysis levels in the "Analyzer Function" panel.
   The measurements are set in the order of their importance:
   - Measurements at the function level, e.g. distortion measurements (possibly with Post FFT enabled)
   - Settings at the monitor level, e.g. DC measurement
   - Display of the peak value at the input monitor level
   - Display of frequency, phase/group delay in the freq/phase level

   In addition, the waveform function can be switched on and off in this panel.



3. If the monitor outputs at the rear of the instrument are to be used, these settings are made in the "Auxiliaries" panel.



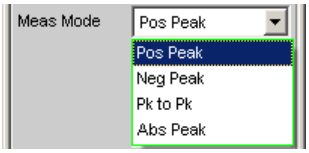
4. The following settings can be made in other panels:
   - the way in which the measurement results are to be displayed (numerically or graphically)
   - scaling
   - limit monitoring
   - minimum and/or maximum values
   - and many other parameters

4.3 General Information on Operation

4.3.1 Windows User Interface

To provide the user with a familiar environment, operation is largely based on the Windows® user interfaces. All panels, entry windows, etc., are made up of known elements, for example:

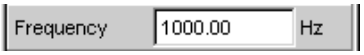
- Selection fields with parameter lists



- Checkboxes

- Radio buttons

- Entry fields



A blue, green or magenta selection frame or the highlighting of an entry field (dark background) indicates the current entry focus. Entries can be made in the element with entry focus.

Operation follows the same basic rules which apply to other Windows programs in use today. It is assumed that the user is familiar with these basic rules. This information is therefore not given in detail in this manual.

4.3.2 Operation Using the Mouse

Similar to other Windows® programs, the R&S UPP can also be operated with a mouse. To permit this, a commercially available mouse (not supplied with the instrument) is connected to one of the four USB interfaces at the front or rear of the instrument (see chapter 2.8.2, "Connecting an External Mouse", on page 43).

The mouse makes it easier to move and resize the panels and graphical windows on the screen and provides alternative control options. It allows easy operation of Windows®.

Specifically for mouse operation, the R&S UPP also features a menu bar that either can be displayed permanently at the top of the screen or appear at the top of the screen as soon as the mouse pointer is moved to the left side of the screen, and a toolbar that either can be displayed permanently at the top edge of the screen of appear at the right side of the screen as soon as the mouse pointer is moved there. In both cases, the permanent display is set in the config panel under the heading "Always visible". This toolbar contains a number of icons for calling up frequently used functions.

The functions of the mouse correspond to the following instrument functions:

Mouse	Function
Left-click	• Activates selection fields • Selects parameters • Activates/deactivates checkboxes • Toggles radio buttons • Quits the Edit mode
Moving the mouse pointer to left-hand edge of screen	• Shows the menu bar
Moving the mouse pointer to right-hand edge of screen	• Shows the toolbar
Turning the mouse wheel	• Navigation in panels, parameter lists, etc. • Changes numeric values
Pressing the mouse wheel	• Selects parameters • Quits the Edit mode

4.3.3 Operation Using an External Computer Keyboard

A commercially available, external computer keyboard (not part of the scope of deliveries and services) can be connected to one of the four USB interfaces at the front or rear of the instrument (see chapter 2.8.1, "Connecting an External Keyboard.", on page 43).

It simplifies the input of list entries, comment texts, file names, etc. A keyboard is required for operating Windows®.

The keys or shortcuts on the external computer keyboard correspond to the following instrument functions:

Computer key-board	Function		Computer keyboard	Function
F5 to F12	Softkeys 1 to 8		0 to 9; a to z	0 to 9; a to z
CTRL + F5	START		SPACE	Space
CTRL + F6	SINGLE		● ; * … #	● ; * … #
CTRL + F7	STOP CONT		+ / -	+ / -
CTRL + F8	Audio monitor on/off		SHIFT + A to Z	A to Z
CTRL + F9	Level of audio monitor		CTRL + M	MENU bar
CTRL + P	Hard copy		BACKSPACE	Undo last action
CTRL + F10	Switching Off		ESC	Exit selection without changes
CTRL + F11	Switch from remote to local		ENTER	Enter
CTRL + F12	Switch off all out-puts		Cursor keys	Cursor keys
CTRL + PAGE UP	Scroll screens backward		ALT + W	Switch WINBAR on/off; Activating windows that are in the background.
CTRL + PAGE DOWN	Scroll screen for-ward		ALT + M	MODIFY softkey bar for size and position change of windows in predefined increments only with the help of softkey buttons. Size and position change using the keys TAB or SHIFT+TAB.
CTRL + SHIFT + TAB	Scroll WINDOW backward		ALT + H	Reduce window
CTRL + TAB	Scroll WINDOW forward		ALT + C	Close window
ALT + PAGE UP	Scroll SCAN back-ward		F1	Displays a help page for the currently selected parameter field
ALT + PAGE DOWN	Scroll SCAN for-ward		ALT + S	Opens a dialog box for saving instrument set-tings.
PAGE DOWN	PAGE ▽		ALT + L	Opens a dialog box for defining instrument set-tings.

Computer keyboard	Function		Computer keyboard	Function
PAGE UP	PAGE Δ		ALT + P	PRESET function switches the instrument to default setting
TAB	Scroll down in selection lists, variation of numeric values in input fields			
SHIFT+TAB	Scroll up in selection lists, variation of numeric values in input fields			

4.4 The Display

The display is the central element for operating the audio analyzer. Both the instrument settings in the various panels and the measurement results are displayed here.

To make the various functions of the audio analyzer easier to operate, they were organized in a series of panels.

The measurement results can be displayed as digital numeric values, in data lists, in analog bar graphs, or in result graphics. The user can freely choose the number of panels and the number of graphical windows to be shown in the display. The size of the panels can be changed within wide limits, whereby the font size, scaling and so on are adapted automatically according to the type of display window.

4.4.1 The Screens

Five display windows (or "screens") are provided so that the wealth of information can be better organized.

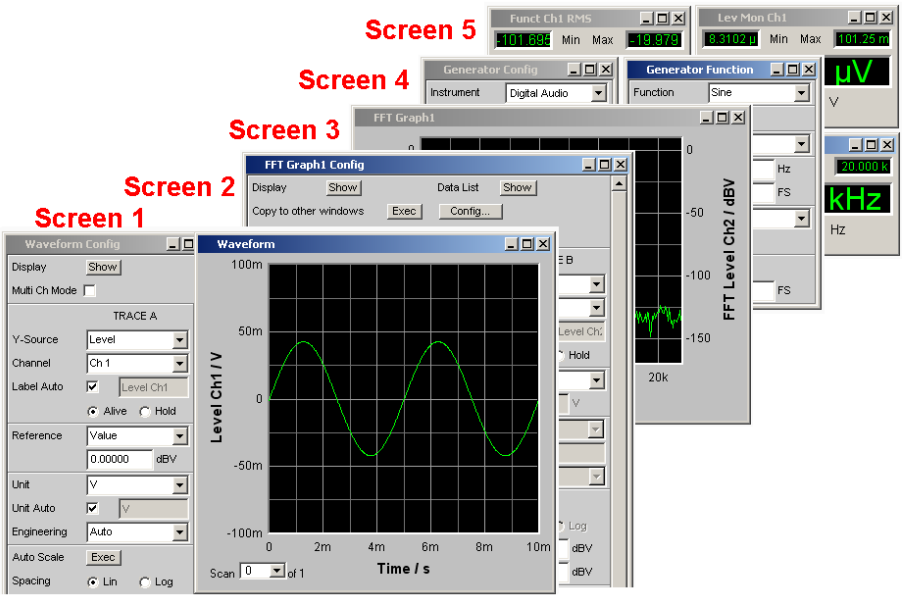
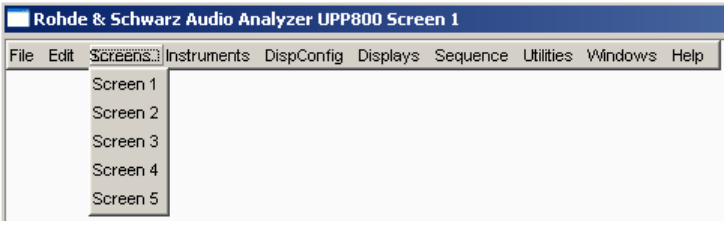


Fig. 4-1: R&S UPP display with its 5 screens

The user can toggle between the individual screens in the following way:

- **Computer keyboard**: with the shortcuts CTRL + PAGE UP or CTRL + PAGE DOWN
- **Mouse**: first open the menu bar at the top of the display then click on the Screen button and finally select the desired screen.



- Alternatively, you can also select the desired screen directly by **clicking it on the toolbar**.

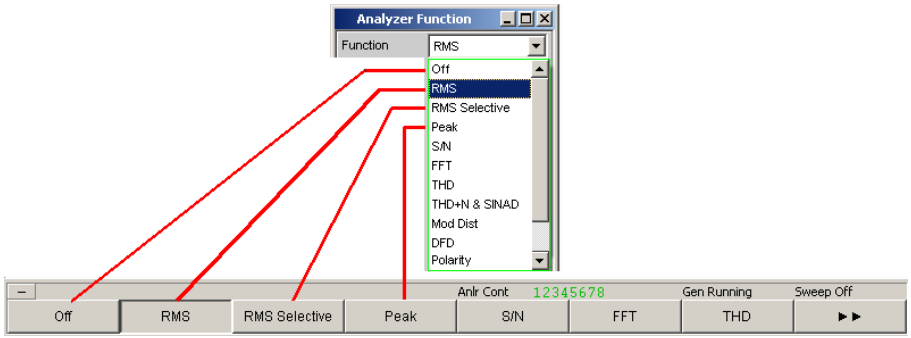
4.4.2 Softkeys

The softkey bar which has a varying range of functions is visible in normal operating mode.

In most cases, the functions available in the selection windows of the panels are displayed in the eight buttons; these functions are displayed even if the parameter lists have not (yet) been opened. The labeling of these buttons indicates the functions of the softkeys underneath them.

The function that has just been selected is indicated by a "pressed" button, as shown in the example below for the "RMS" function.

If there are more than eight elements to choose from, the hidden elements in the selection list can be displayed by pressing the last softkey containing the >> symbol or the first softkey containing the << symbol.



Pressing the respective softkey permits rapid selection.

Softkeys with an additional checkbox are also used for a number of applications. In the example below, the left-hand softkey F5 can be used to activate and deactivate the X cursor in a curve diagram. The other softkeys are used to make other settings affecting this cursor. The advantage of this combination is that the user can activate/deactivate a function (here the cursor) using one button and at the same time use the other softkeys for additional settings.

If an external computer keyboard is used, the softkeys can be operated using the F5 to F12 keys; if a mouse is used, the buttons in the softkey bar can be clicked directly.

Function	Computer keyboard	Mouse
Select softkey function	Press keys F5 to F12.	Click button of associated softkey.

4.4.3 Moving and Resizing Panels and Graphical Windows

As soon as a panel or display window is active, it can be operated and moved on the screen using the mouse

- by grabbing the title bar and dragging it to the desired position, or
- changing its size by grabbing its edges or corners and resizing it.

4.4.4 Status Displays and Messages

In some cases, the user is presented with additional information on the screen. This information includes status messages, messages concerning the value ranges, information on settings, warnings and error messages.

4.4.4.1 Status Displays

The status of the R&S UPP is continuously displayed for the generator, analyzer, sweep system and other instrument states at the bottom of the screen above the four right-hand softkeys. Status displays always appear at the same position; they are assigned to the fields above the softkeys as shown below.

A list of all possible status messages is available, see chapter 4.20, "Overview of Status Messages", on page 183.

4.4.4.2 Valid Value Range

Information on the possible entries is given at the bottom of the screen above the softkey bar. The ranges for value entries specified here always take the current status of the instrument into consideration and therefore depend on the presets already configured. Below is an example for entry of the generator output voltage:

4.4.4.3 Notes

Information concerning the panel settings and so on is also given at the bottom of the screen above the softkey bar (only the space above the four left-hand softkeys is used).

4.4.4.4 Warnings

If the user attempts to make measurement settings which conflict with the usual test specifications, warnings appear on the screen and remain there until they are acknowledged with ENTER or a mouse click on OK.

Warnings are issued if no measurement results are produced during measuring mode. This is normally the result of unsuitable input signals or settings. For example, input signals may be too low to produce a stable measurement result. In this case, a warning is displayed in the middle of the screen instead of the measurement result. The warning indicates why no measurement result can be displayed and may also list several reasons for this.

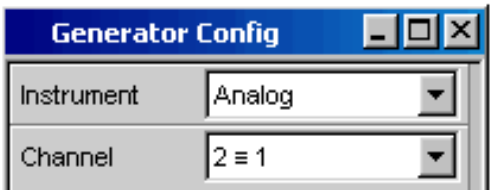
4.4.4.5 Error Messages

If faults in the instrument occur during operation, an error message appears in the middle of the screen. This message remains on screen until it is acknowledged with ENTER.

4.5 Panels

In the case of the audio analyzer, associated settings and functions are always combined in "panels". Each of these panels has a name (headline in the title bar) by which it is called up.

Only one panel can have the focus, i.e. only one panel can be active at any one time. The panel with the focus can be identified by its blue title bar.



The audio analyzer distinguishes between the following panels and display windows:

- **Control panels** used to make function settings
- **Configuration panels** used for configuring how the measured values are to be displayed
- **Numeric display fields** for displaying the measured values of the various measurement functions
- **Combo displays** in which the numeric display of measured values can be supplemented by bar graphs, min/max values and limit monitoring
- **Graphical windows** in which measured values are displayed in the form of diagrams
- **Measured value lists** in which the measured values are listed in tabular form.

A detailed list of all panels together with the most important setting parameters can be found at the end of this chapter (see chapter 4.19, "Overview of Panels and Measurement Displays (Graphical Windows)", on page 180).

4.5.1 Opening, Operating, Hiding and Closing Panels

Each panel and display window is a separate panel which can be either closed, opened or hidden. All displayed panels/display windows on the currently visible screen are designated as open. If the panel size is minimized and moved to the bottom edge of the screen, it is referred to as hidden.

The same panel or display window can be displayed (i.e. opened) in several screens. The display characteristics (position, size) can be different for each of the screens; the content is, however, always the same.

- **Open panel**
  Panels/display windows are open if they are visible on the currently displayed screen.
  A panel is opened on the currently displayed screen by activating the menu bar, moving the mouse over the "Instruments", "DispConfig" or "Displays" selection items and clicking on a panel in the pulldown menu that opens.
- **Activate panel**

Only one panel can be active on the screen at any one time.

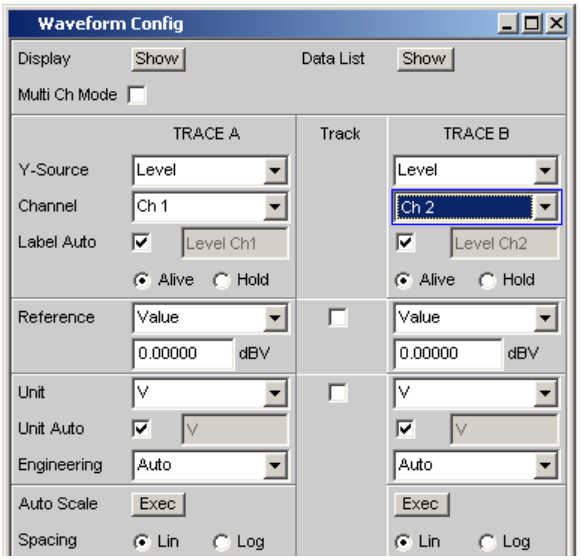
- **Hide panel**
  Open panels/display windows can be minimized and placed at the bottom of the screen. They are then referred to as hidden in the menu bar.
  A panel must be activated before it can be hidden. Clicking on the left icon ( ) in the title bar hides the panel.
- **Close panel**
  Opened panels/display windows can be closed. They are then referred to as closed in the menu bar.
  A panel must be activated before it can be closed. Clicking on the right icon ( ) in the title bar closes the panel.

The table below shows the operating modes for mouse and external keyboard:

Function	Computer keyboard	Mouse
Open panel	Press the shortcut CTRL+M to open the menu bar, then highlight the Instruments, Disp Config or Displays button using the TAB or SHIFT+TAB keys, open the pull-down menu using the Enter key, highlight a panel using cursor keys and select it with the Enter key.	Open the menu bar by moving to left edge of screen, press the "Instruments", "Disp Config" or "Displays" button and click the desired panel.
Activate panel	---	Click anywhere in the desired panel. With hidden panels: Press the shortcut ALT+W (WINBAR), then bring the desired panel to the foreground using the corresponding softkeys.
Hide panel	Pressing the shortcut ALT + H hides the currently active panel.	Click on the left button (_) in the title bar of the corresponding panel.
Close panel	Pressing the shortcut ALT+C closes the currently active panel.	Click on the right button (**X**) in the title bar of the corresponding graphical window.

4.5.2 Panel Structure

This section describes the panel structure. To operate the panels on the screen, see chapter 4.5.1, "Opening, Operating, Hiding and Closing Panels", on page 114, to set the parameters, see chapter 4.7.8, "Selecting a Parameter – Selection Fields", on page 123. The panels have the look and feel of the Windows® interface. They differ in detail depending on their function but they consist of the same main elements.



Panels consist of up to three columns, depending on the function block on which the panel is based. For example, two-channel functions are operated in panels with two columns. When defining graphical windows, settings from Trace 1 can be applied to Trace 2 in a third column between the two original columns so that trace 2 does not have to be configured separately.

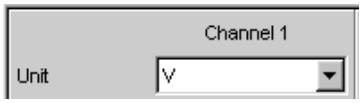
Each panel contains a selection of different parameter fields which are combined in groups. Various types of parameter fields, which are operated in different ways, are used. The parameter fields have labels indicating their function.

Panels consist of the following elements:

- **Title bar**

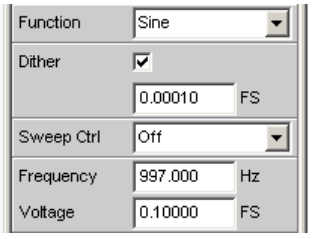
  The top field contains the name of the panel (here: "Analyzer Function") and the title bar buttons for hiding and closing the menu. The buttons can be operated with the mouse.
  The button maximizes graphical windows so that they cover the entire screen (see chapter 4.4.2, "Softkeys", on page 111).

- **Headlines in panels**

  With multi-column panels, each column has a headline.

- **Function groups**

In panels, parameter fields which belong together with respect to their function are frequently combined in function groups. Gray lines indicate these groups.

- **Numeric entry field**

A numeric value (e.g. the frequency) can be entered in this field.

- **Units**
The unit of a numeric value is displayed next to the entry field (see above). When the value is entered, all possible units are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey. The unit can be changed after the entry has been made. In this case, the physical value remains unchanged; however, the value displayed in the entry field is adapted automatically to the changed unit.
- **Text entry field**

An alphanumeric value (e.g. label text) can be entered in this field.

- **Button**

Buttons are used to trigger actions; here, for example, to display a measurement graph.

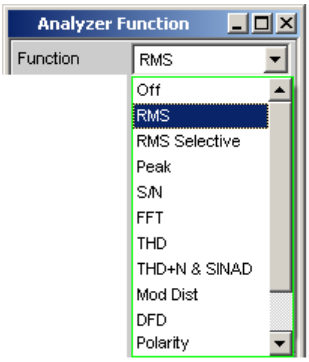
- **Checkbox**

If a checkbox is activated, the assigned setting is selected or enabled.

- **Radio button**

Radio buttons are used to toggle between two settings with just a single click. Only one of the two options can be active at any one time.

- **Selection field**



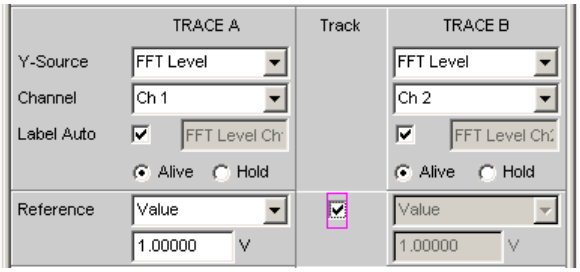
The button indicates that a parameter list is available. The pulldown parameter list is displayed below the selection field. Depending on the number of items, the

full list or only part of it is shown. Only one item at a time can be selected from the parameter list.

- **Display Fields**

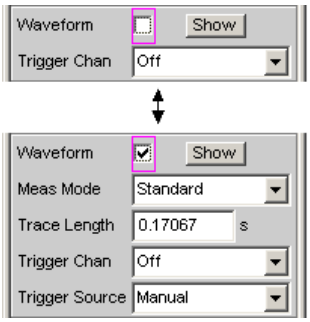
Some settings can only be made in a specific configuration. If the setting is not permitted with the specific configuration selected, the respective item is disabled and displayed in gray and the field cannot be accessed. In this case, the field acts as a display field, i.e. the value displayed there corresponds to the value actually set.

- **Track box**



With multi-column panels, settings can be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time. If the track box is activated, all of the settings within the function group apply to both columns. All fields with transferred settings are shown as display fields and cannot be accessed while the track function is active.

- **Hidden parameter fields**



In general, an effort has been made to keep the panels as short as possible. For this reason, unneeded fields are hidden. The above example shows this: The fields "Meas Mode", "Trace Length" and "Trigger Source" appear only if the Waveform function is activated.

4.5.3 Navigating in the Panels

If a panel has more fields than can be displayed on the screen or if the size of the panel has been fixed such that its full length cannot be displayed, a scrollbar appears along the right-hand side of the panel. The length of the scrollbar symbolizes the overall length of the panel; the dark part of the scrollbar indicates which section of the panel is currently visible.

The mouse can also be used to move inside the panels in the same way as other Windows® applications, i.e. by directly clicking the desired parameter fields or by moving the scrollbar.

4.6 Settings on the Audio Analyzer

The parameters of R&S UPP are set with an external keyboard and a mouse (see chapter 4.3, "General Information on Operation", on page 107).

Most of the parameters are set in the panels. The panels are operated on the screen as described in the section Opening, Operating, Hiding and Closing Panels. How to enter and select setting parameters in the panels is described in the following sections; a detailed description of all setting parameters is described in detail in chapter 5, "Instrument Function", on page 185.

Entries for file management tasks, such as saving and loading instrument settings, saving files, and so on, are made in special panels, see chapter 4.15, "File Management", on page 169.

A number of settings are made via the menu bar. This includes all settings that configure the R&S UPP as a complete instrument, e.g. the setting of the IEC bus address, function of the HCopy key, etc. For more detailed information, see chapter 4.9, "Settings in the Menu Bar", on page 158 and chapter 5, "Instrument Function", on page 185.

The R&S UPP is equipped with the Windows XP operating system. Settings at system level are only rarely required, e.g. installation of a new printer driver. Connecting a keyboard and mouse makes Windows easier to use.

4.7 Settings in the Panels

In the panels of the R&S UPP audio analyzer, associated settings and functions are combined. Each function block has its own panel.

4.7.1 Focus

Panels can only be operated if they have the focus (indicated by the blue title bar).

Before settings can be made in a panel, the relevant parameter field must be highlighted, i.e. it must have the focus. This is indicated by a selection frame which is blue, green or magenta depending on the entry mode.

The colors of the selection frame have the following meaning:

- A blue selection frame indicates a highlighted field.

- A green selection frame highlights fields in which parameters can be selected or in which an entry can be made without the selection / entry having an immediate effect on the hardware of the R&S UPP.

- A magenta selection frame indicates that selecting a button, activating a checkbox or changing a numeric value will be immediately passed on to the hardware and executed.

When the instrument is switched on, the most recently saved instrument settings are loaded automatically so that the instrument is in the same state as it was before power-off. The focus is placed on the first position of the active panel.

Panels are opened using the menu bar (see chapter 4.5.1, "Opening, Operating, Hiding and Closing Panels", on page 114). How to move the focus has already been described earlier, see chapter 4.5.3, "Navigating in the Panels", on page 118.

4.7.2 Changing the Instrument

Depending on the installed options, the audio analyzer can be used at analog and digital interfaces. Each of these interfaces determines the basic characteristics of the instrument, whereby these characteristics are separate for generator and analyzer. These interface characteristics define quasi-independent instruments within the R&S UPP. The settings for these instruments are made in the selection field in the first field of the "Generator Config" and "Analyzer Config" panel.

Each of these instruments has its own data set. If a different instrument is selected, this data set is saved. As a result, the previous settings are available when the original instrument is selected again.

The data set is structured differently for each instrument. The data sets differ with regard to the following points:

- **Selection of parameter fields / parameters:**
  Example: In the case of analog instruments, all settings for configuring the analog interfaces are available (e.g. coupling); all settings for the other instruments, e.g. the digital sampling rate and so on, do not appear in the panel but remain in the background.
- **Valid value range of parameters**
  The frequency ranges in the different instruments may be different.
- **Units used**
  Levels are output in different units in analog and digital applications.

The examples given above show that the choice of instrument not only affects the "Generator Config" and "Analyzer Config" panel, but also has an effect on the other panels.

4.7.3 Changing Functions

The principles that apply to changing an instrument also apply to changing functions (e.g. from an RMS measurement to a THD measurement or from generating a sine-wave to multi-tone signal):

Each measurement function and generator function has its own data set. If a different function is selected, this data set is saved. As a result, the previous settings are available again when a different function is selected.

The data set is structured differently for each function. The data sets differ with regard to the following points:

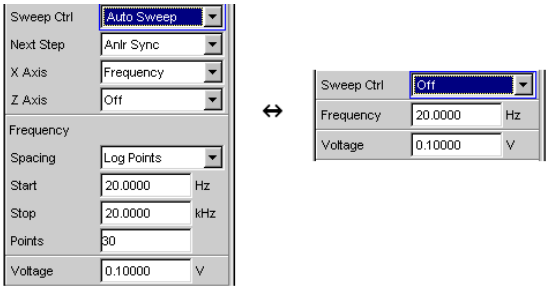
- **Selection of parameter fields / parameters:**
  Example: With the RMS measurement, various measurement times are offered; which is not the case for the FFT analysis.
- **Valid value range of parameters**
  Example: Other frequencies can be set for intermodulation test signals than for sine-wave signals.
- **Units used**
  Example: THD measurements and level measurements are specified in different units.

The following generally applies: All the settings for the other functions, e.g. filter settings and so on, remain in the background with the function settings and are displayed in the panel and set in the instrument again the next time this function is called up.

4.7.4 Hiding Parameter Fields

The R&S UPP always attempts to keep the panels as short as possible. For this reason, unneeded fields are hidden.

The following example demonstrates this more clearly: As soon as "Auto Sweep" is selected in the "Sweep Ctrl" menu item in the "Generator Function" panel, all of the fields required for configuring the sweep are displayed in the panel (together with the parameters set for the sweep last performed). If the sweep is deactivated, all of the sweep parameter fields are hidden. The user is presented with a shorter panel and is not burdened with parameter fields which are currently not needed.



The sequence of the individual parameter fields in the panel is such that changes to parameters usually only cause changes in the fields below. Therefore, we recommend beginning at the top of the panel and working down.

4.7.5 Highlighting Controls

A control element is always selected in the same way, regardless of whether it is a checkbox, radio button, entry field and so on.

A control element is activated by shifting the focus to this element. The entry focus is indicated by a blue, green or magenta border.

The entry focus is moved with the mouse.

4.7.6 Activating/Deactivating Functions – Checkboxes

A checkbox is always used for functions which can be activated and deactivated only. If the checkbox is activated, the assigned setting is selected or enabled.

To activate or deactivate a function, click on the corresponding element using the mouse. Clicking repeatedly acts as a toggle function.

Function	Computer keyboard	Mouse
Activate/deactivate	Highlight the desired element with cursor keys, Switch the function with the Enter key.	Click checkbox.

4.7.7 Toggling Functions – Radio Buttons

Radio buttons are used for functions which can be toggled between two settings. A black dot in the appropriate button indicates the selected status.

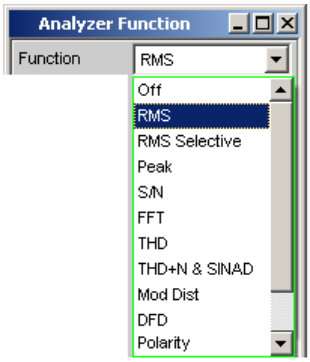
Only one of the two options can be active at any one time.

To toggle a function, click on the corresponding radio button using the mouse.

Function	Computer keyboard	Mouse
Toggle	Highlight the desired element with the cursor keys, Toggle the function with the Enter key.	Click the desired radio button.

4.7.8 Selecting a Parameter – Selection Fields

Activating the adjacent button displays a selection field. As soon as a parameter field has the focus, a list for selecting the available parameters can be opened with the ENTER key or by opening a list for selecting provided parameters with a click of the mouse. The fold-down parameter list is displayed below the selection field.



When using a mouse, items can be selected and activated by clicking on them. Only one entry can be selected at any given time.

The parameter list can be exited without adopting the highlighted parameter by pressing the ESC key.

If the list is longer than the displayed window, a scrollbar is available.

Note 1:

The contents of the parameter lists are not fixed but vary depending on other settings selected.

Note 2:

Alternatively, parameters can also be selected using the softkeys.

Function	Computer keyboard	Mouse
Open parameter list	Press the Enter key.	Click button.
Scroll	Move the displayed section of the list using the up/down cursor keys.	Activate the UP or DOWN button in the scrollbar until the desired entry is displayed.

Function	Computer keyboard	Mouse
Select parameter	Highlight the selection using the up/down cursor keys and press the Enter key.	Click parameter.
Exit the parameter list without adopting a setting	Press the ESC key.	Click anywhere outside parameter list.

4.7.9 Numeric Entries – Numeric Entry Fields

Numeric values (e.g. the output voltage) can be entered or edited in these fields.

This can be done is various ways. However, the following applies irrespective of the chosen method:

Entries outside the possible value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.

4.7.9.1 Value Inputs in Edit mode – Green Selection Frame

When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame. In addition, the current numeric value is highlighted with a blue background.

If the value must be completely re-entered, simply start entering numbers using the external computer keyboard; the first keystroke automatically deletes the old value. The digit to the left of the cursor can be deleted at any time during entry using the <-- key.

If only certain digits are to be changed, position the cursor accordingly using the cursor keys or digit cursor and enter the new digits (if the position of the digit cursor is changed before the first digit is entered, the old value will not be deleted). The ADD or INSERT key can be used to switch between insert and overwrite mode.

The numeric entry field is closed with:

- **ENTER**
  The newly entered value is adopted.
- **ESC**
  The old value is retained.
- **Softkeys**
  The selected unit is set and adopted together with the newly entered value.
- **"m" or "k" on the external keyboard**
  The number entry can also be completed with the entry of the unit. Simply entering values such as "m" to the set voltage value to mV or "k" to set a frequency value to kHz is sufficient here.

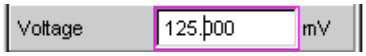
The entry is set in the hardware as soon as the numeric entry field is closed.

Only the number keys and cursor keys are accepted; letters and special characters have no effect when numeric values are being entered.

4.7.9.2 Value Inputs in Direct mode – Magenta Selection Frame

When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.

Pressing the ENTER key switches to Direct mode and the selection frame changes to magenta.



The digit cursor then moves to the first digit to the right of the decimal point or, if there is no decimal point, to the digit at the extreme right.

A digit can now be entered using the keyboard; the digit at the cursor position is replaced. The cursor does not change its position.

The digit cursor can be placed at a different position at any time using the cursor keys. Digits are then entered at the new position.

Entries in Direct mode always use the overwrite mode.

In Direct mode, every setting change is immediately passed on to the hardware and executed. For this reason, this method is particularly suited for adjustment work.

Direct mode can be exited with ENTER, ESC or by clicking in a different field with the mouse.

Only number keys and cursor keys are accepted; letters and special characters have no effect.

Changes made to values are not accepted if the entries are outside the possible value range; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.

4.7.9.3 Entering/Changing the Unit of a Value

The unit of a numeric value is displayed next to the entry field. When the value is entered, all units available for the respective function are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey.

This is done differently depending on the selected mode:

- **In Edit mode**, the newly entered numeric value is adopted and set together with the selected unit.
- **In Direct mode**, the physical value (number with the previously selected unit) is converted to the newly selected unit and adopted as the new numeric value.

After finishing entering a value or even if no value has been changed, the softkeys can be used to change the unit in any highlighted numeric field. In this case, the physical

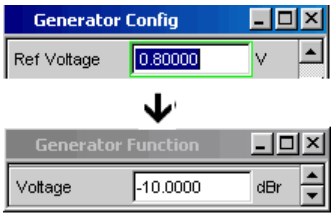
value remains unchanged (as in the Direct mode); however, the value displayed in the entry field is adapted automatically to the changed unit. This function allows numeric values to be "converted" to other units very easily.

4.7.9.4 Information on Using Reference Values when Entering Values

The audio analyzer allows reference values in various places. These reference values are used as a basis for settings for other parameters.

The example below explains these interdependencies:

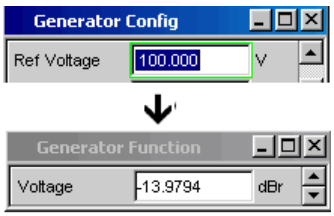
A reference voltage ("Ref Voltage") can be set in the "Generator Config" panel. The actual output voltage is set in the "Generator Function" panel where the unit is dBr, i.e. it is possible to enter the output voltage in dB relative to this reference value.



This method is particularly useful if, e.g. with an A/D converter, the clipping level has been determined and other measurements (frequency response, THD+N, etc.) have to be performed using test signals which are a certain dB value (defined in the test specifications) below this full-scale level.

It should be noted, however, that the maximum values of the R&S UPP cannot be exceeded, both for system reasons and due to the "Max Voltage" setting.

If the maximum output voltage is exceeded by increasing the reference value, the reference-based value in the "Voltage" field of the "Generator Function" panel is automatically reduced. In the following example, the maximum output voltage of 20 V forms the limit. The setting of the reference value to 100 V leads to a reduction of the value in the lower window.



Function	Computer keyboard	Mouse
Entering a new value: (Edit mode)	Highlight the numeric entry field and enter the new value directly using the number keys.	---
Changing individual numbers (Edit mode)	Highlight the numeric entry field, position the digit cursor with the > or < cursor keys and enter the new digit directly using the numeric keys.	---

Function	Computer keyboard	Mouse
Finishing value entry	Complete entry with the ENTER key.	---
Finishing value entry with unit selection	Use the F5 to F12 keys to select the desired unit or Complete the entry with the keys m, k, etc. to enter the value, e.g. as mV or kHz.	Click the softkey button with the desired unit.
Exit value entry without adopting the value	Press the ESC key.	Click in a different entry field.
Changing a value (Direct mode)	Highlight the numeric entry field, switch to Direct mode with the Enter key, position the digit cursor with the > or < cursor keys and enter the new digit directly using the numeric keys. All changes are set directly in the hardware.	---
Varying a value (Direct mode)	Highlight the numeric entry field, switch to Direct mode with the Enter key; position the digit cursor with the > or < cursor keys. Change the numeric value with the UP/DOWN cursor keys. All changes are set directly in the hardware.	---
Changing units	Highlight the numeric entry field, select the unit using the F5 to F12 keys. The physical value is converted to the new numeric value with the newly selected unit.	Highlight the numeric entry field, click the appropriate softkey button to select the unit. The physical value is converted to the new numeric value with the newly selected unit.

4.7.10 Alphanumeric Entries – Text Entry Fields

When the focus is moved to a text entry field, the system enters Edit mode, which is indicated by a green selection frame.

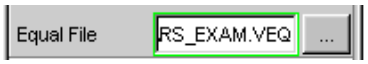
The first key stroke automatically deletes the old text. Enter characters as usual.

If certain characters only are to be changed, position the cursor accordingly using the cursor keys and enter the new characters (if the position of the cursor is changed before the first character is entered, the old text will not be deleted). The default setting is insert mode. It is only possible to change between insert and overwrite mode if an external computer keyboard is used.

The text entry field is closed with:

- ENTER – The newly entered text is adopted
- ESC – The old text is retained.

Whenever files stored on the R&S UPP are to be called up, e.g. to load saved scans in a diagram, or special functions are to be adopted from files, etc., a text entry field also appears. Here, the file name can be typed or the ••• button can be activated to call up the file directory where the desired file can then be selected. For details, see chapter 4.15, "File Management", on page 169.



Function	Computer keyboard	Mouse
Entering new text	Highlight the text entry field and enter the new text directly using the keyboard.	---
Changing individual characters	Highlight the text entry field, position the cursor with the cursor keys and enter the new character directly using the keyboard.	---
Finishing character entry	Complete entry with the ENTER key.	---
Exiting text entry without adopting the entered characters	Press the ESC key.	Click in a different entry field.

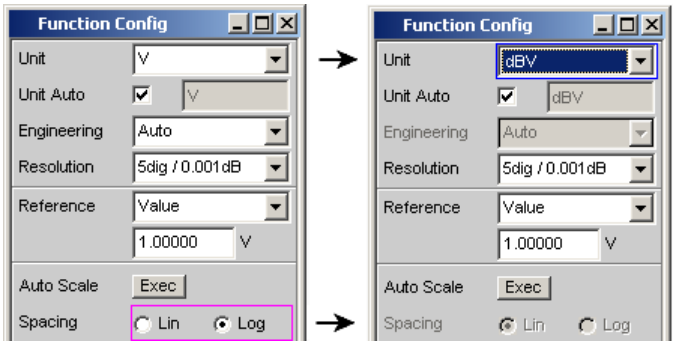
4.7.11 Display Fields

Sometimes it is very useful for operators to receive additional information about their settings. For example, the selected FFT parameter directly affects the frequency resolution in the displayed spectrum. Display fields inside the panels are used in such cases. These fields are shown in gray and cannot be accessed. They always contain valid values and therefore always show settings active in the background; the fields are updated as soon as a setting in the associated parameter field is changed.

Depending on the settings selected beforehand, it may in some cases no longer be possible to operate certain elements – the entry field then becomes a display field and is shown in gray as described above.

Example: If measurement results are displayed in V, linear or logarithmic divisions can optionally be selected for the bar graph. For measurement results in logarithmic units, only a linear subdivided bar graph is meaningful; for this reason, the input field cannot be changed and, by default, is displayed with the "Lin" setting.

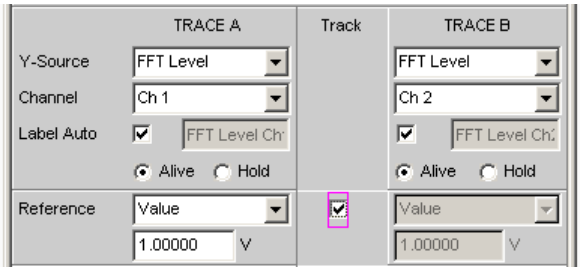
Display fields are also used when adopting parameters using track boxes.



4.7.12 Adopting Parameters – Track Box

In many cases, settings are to apply e.g. to both measurement channels or to both traces. Here the R&S UPP provides multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time.

The track boxes, which are displayed in a separate column, are used for this purpose. Track boxes always apply to an entire function group.



If the track box is activated, all of the settings within the function group apply to both columns. All fields with transferred settings in the right-hand column are shown as display fields. They appear gray and cannot be accessed while the track function is active. If a setting is changed in the associated parameter field in the left-hand column, this change is also shown in the display field in the right-hand column.

4.7.13 Input Help

Information on the possible entries is given at the bottom of the screen above the softkey bar. The units offered in the softkey bar and the limits specified in the "Valid Range" field always refer to the highlighted parameter field. The valid value range is given in the unit currently selected.

Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

The specified ranges for value entries always take the current status of the instrument into consideration. They are therefore not constant and depend on the presets already configured for other parameters.

Below is an example for entering the generator output voltage: Additional units can be selected with the >> button:

4.7.14 Completing Settings

For the entry of numeric values, the R&S UPP distinguishes between Edit mode (identified by a green selection frame) and Direct mode (identified by a magenta selection frame). See also the section chapter 4.7.9, "Numeric Entries – Numeric Entry Fields", on page 124.

- Numeric entries in **Edit mode** are adopted and set in the hardware only by using ENTER or selecting a unit via the softkey bar.
- In **Direct mode**, numeric values entered or changed using the mouse wheel are immediately passed on to the hardware and executed.

With checkboxes, functions are activated and deactivated by the hardware as soon as the status of the checkbox is toggled with the ENTER function. For operation using a mouse, functions are activated/deactivated as soon as the checkbox is clicked.

With radio buttons, settings are executed by the hardware as soon as the radio button is toggled with the ENTER function. For operation using a mouse, functions are toggled as soon as the corresponding radio button is clicked.

A parameter from a selection field is also executed by activating the ENTER function. In this case, a simple mouse click will select and activate the desired parameter.

Most settings are made without any noticeable adjustment or calculation times. If a brief calculation time is necessary (e.g. to calculate a multi-tone signal adapted to the FFT analysis), the calculation is performed in the background while ongoing measurements continue.

Function	Computer keyboard	Mouse
Finishing numeric value entry (Edit mode)	Complete entry with the ENTER key or Use the F5 to F12 keys to select the desired unit or Complete the entry with the m, k, etc. keys to enter the value, e.g. as mV or kHz.	Click the softkey button with the desired unit.
Immediately setting numeric value changes in the hardware (Direct mode)	Highlight the numeric entry field, switch to Direct mode with the Enter key, position the digit cursor with the > or < cursor keys and enter the new digit directly using the numeric keys.	---

Function	Computer keyboard	Mouse
Varying numeric values with immediate adoption by hardware (Direct mode)	Highlight the numeric entry field, switch to Direct mode with the Enter key; position the digit cursor with the > or < cursor keys. Change the numeric value with the UP/DOWN cursor keys.	---
Activating/deactivating a function	Highlight the desired element with the cursor keys, Switch the function with the Enter key.	Click the checkbox.
Toggling a function	Highlight the desired element with the cursor keys, Toggle the function with the Enter key.	Click the desired radio button.
Selecting a parameter from a list	Highlight the selection using the up/down cursor keys and press the Enter key.	Click on the parameter.

4.7.15 Entries during Measurement or Data Output

All entries can be made at any time.

- **Single measurements, spectral displays:**
  If the entry affects parameters of the ongoing measurement, the ongoing measurement or output is terminated as soon as the entry is confirmed (the newly selected parameters are set and the measurement or output is restarted).
- **Sweep activated:**
  Since changes to parameters during a sweep can influence the measurement and thus have a negative effect on the reliability of the results displayed in the screen graphics, the current sweep is stopped and then restarted for entries of this kind.
- **Entries which do not affect the measurement process:**
  Entries which do not affect the ongoing measurement process (e.g. changing a unit) are adopted immediately without the ongoing measurement being interrupted.

4.8 Measurement Displays

The audio analyzer offers various types of measurement windows for displaying the results of the numerous measurement functions. The measurement results can be displayed as digital numeric values, in analog bar graphs, in result graphics or in data lists. The user can open any number of measurement windows on the screen. The size of the panels can be changed within broad limits, whereby the font size, scaling and so on are adapted automatically; see also chapter 4.4.3, "Moving and Resizing Panels and Graphical Windows", on page 112.

4.8.1 Measurement Functions and Displaying Measurement Results

- **What** (which measurement function) is measured and **how** (which measurement method) measurement is performed, is preset in the "Analyzer Function" panel.
- The **configuration panels for measured value display** are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc.). A series of panels for the different measurement windows are provided for this purpose.
- The results are finally displayed in the various **measurement windows**.

The basic settings in these configuration panels and measurement windows are described in the following sections. For a detailed description of the individual parameter fields, see chapter 4.8.2, "Numeric Display Field", on page 132 and chapter 5.43, "Curve, Spectrum and Bar Graph Display", on page 476.

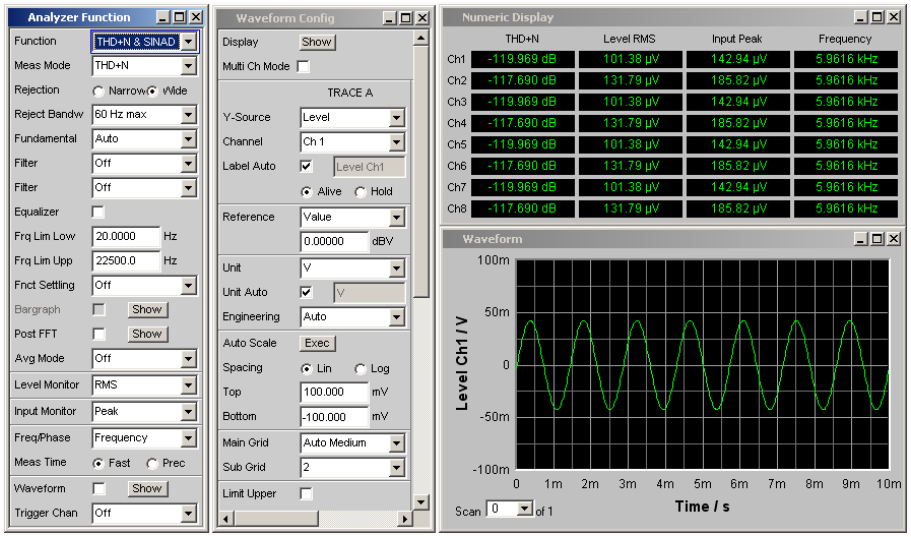


Fig. 4-2: Measurements and display of results for audio analyzer

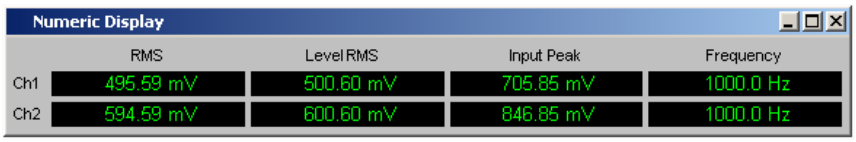
What is measured and how the measurement is performed: = Analyzer Function
Type of displays of measurement results = Waveform Config
Display of measurement results = Numeric display and measurement graph (here: waveform)

4.8.2 Numeric Display Field

The numeric display field provides a clear overview of the numeric values from various analyzer functions and displays a maximum of 32 numeric value results from the "Analyzer Function" panel. The individual columns are permanently assigned, from left to right:

- **Column 1:**
  Measurement results of the function which is set in the "Analyzer Function" panel in the "Function" field.
- **Column 2:**
  Measurement results for the set "Level Monitor" function.

- **Column 3:** Measurement results for the "Input Peak" function.
- **Column 4:**
  Display of either the frequency measurement result or, if "Freq & Phase" or "Freq & GrpDel" is set, display of the frequency measurement result in the first row and display of the phase or group delay measurement in the second row.



Each column is labeled with the name of the displayed measurement function, whereby additional, more specific function-related information may also be shown in some cases. Example: For difference frequency distortion measurement, the type of measurement and the associated measurement standard, e.g. DFD d2 (IEC 268), is also displayed.

The results from the two measurement channels are shown in the measurement fields (exception: frequency/phase or frequency/group delay measurement).

If not all of the columns are required because one or more of the associated measurement functions is deactivated, the column in question is hidden.

The numeric display field is opened via the menu bar and called up using the Displays button.

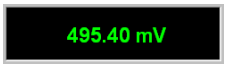
Function	Computer keyboard	Mouse
Opening a numeric display field	Press the shortcut CTRL+M, then highlight the Displays button using the TAB or SHIFT+TAB keys, open the pulldown menu using the Enter key, highlight the numeric display field using cursor keys and select it using the Enter key.	Open the menu bar by moving to left edge of screen, activate the Displays button and click on the numeric display field.

4.8.2.1 Measurement Result Display in a Numeric Display Field

The display of measurement results in a numeric display field is configured in the following panels:

- Function Config
- Level Mon Config
- Input Config
- Freq / Phase Config

The following examples of measured value displays demonstrate the various display options. A number of basic settings made in these configuration panels are described in the following section. A detailed description of the display options can be found in the chapter 5.45.1, "Graphical Display, Explanation of the Elements", on page 552.



If the measured value is within the preset limits or no limits were specified, the measured value is displayed in green on a black background.

A measured value for a linear unit is displayed with 3 to 7 digits; a measured value for logarithmic units can be displayed with a resolution of 0.1 dB up to 0.00001 dB.

If the measured value underruns or overruns the preset limits, it appears red on black.

As soon as the measured value is back within the limits, it changes to green again.

If a measurement channel is switched off, the text OFF appears in the corresponding measured value display.

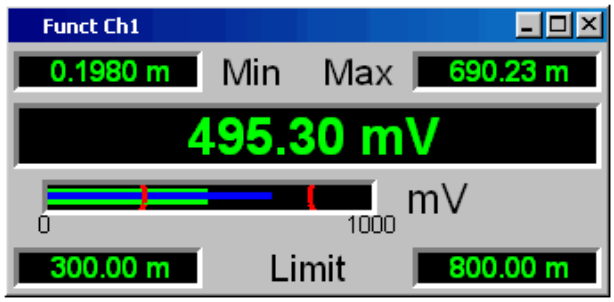
If no measurement result is available (e.g. frequency result for DC measurement), "---" appears.

4.8.3 Combo Display

It is often the case that the numeric value of a measurement result does not contain adequate information. Additional features such as analog bar graphs, limit monitoring or the storage of maximum and minimum values are frequently required.

The combo display is used for this purpose. Additional information can be displayed for every measurement shown in the numeric display.

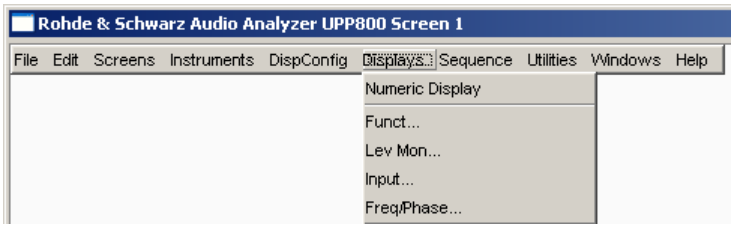
The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the R&S UPP screen from a relatively long distance.



4.8.3.1 Opening Combo Displays

The easiest way to open combo displays is by double-clicking on the corresponding measured value display in the numeric display field.

The combo displays can also be opened via the menu bar: They are located under the "Displays" button underneath the "Numeric Display" option. Depending on the channel number of the selected analyzer instrument, fonts and menu structure for "Display" Function, Lev Mon, Input, Frequency and Phase measurement results change.



Function	PC keyboard	Mouse
Activating a Combo Display via a Numeric Display Field	Select the numeric measurement display with CTRL+TAB or CTRL +SHIFT+TAB. Highlight desired measurement display in numeric display field with TAB or SHIFT +TAB and open combo display with ENTER.	Double-click desired measure-ment display in numeric display field.
Activate combo display via menu bar and Config panel	Select the menu bar with CTRL +M. Select the "DispConfig" but-ton with TAB or SHIFT+TAB. Open the pulldown menu with ENTER. Select the desired Config panel with CURSOR DOWN or CURSOR UP and open it with ENTER. In the Config panel, select the "Display Show" button with TAB or SHIFT+TAB and open the combo display with ENTER.	Click on the "DispConfig" button in the menu bar. Click on the desired Config panel. In the Con-fig panel, click on the "Display Show" button.
Activate the combo display directly via the menu bar	Select the menu bar with CTRL +M. Select the "Display" button with TAB or SHIFT+TAB. Open the pulldown menu with ENTER. Select the desired combo display with CURSOR DOWN or CUR-SOR UP and open it with ENTER.	Click on the "Display" button in the menu bar, then on the desired combo display.

4.8.3.2 Settings for measurement result display in combined fields

Since a combo display is available for each measurement display of the numeric dis-play field, up to 32 of these displays can be opened. The settings for the combo dis-plays (and for the numeric display field itself) are made in four configuration panels, whereby up to 8 measurement channels are displayed in one panel. This results in the following four panels for configuring the measurement results in the combo displays:

- Funct Config
- Lev Mon Config
- Input Config
- Freq / Phase Config

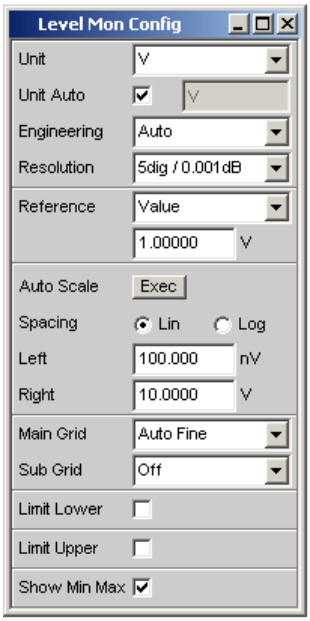
The associated panels for configuring the combo displays are opened via the menu bar; they are called up using the "Disp Config" button.

Function	PC keyboard	Mouse
Open panel for configuring com-bined field or numeric display field	Press shortcut CTRL + M, then highlight Disp Config button using TAB or SHIFT + TAB keys, open the pulldown menu using the Enter key, highlight the desired panel using the cursor keys and select using the Enter key.	Move the mouse pointer to the left edge of the screen, activate the Disp Config button in the menu bar and click on the desired panel.

For the analog analyzer instrument, the Config panels are offered as a single column since the settings apply uniformly to all channels. For the other analyzer instruments, the Config panels are offered in two columns since each channel can be configured by itself.

Some of the basic settings in these panels are described here using the "Lev Mon Config" panel as an example. Since the combo display is an extension of the numeric display field, the settings also influence the numeric display field.

For a detailed description of the display options, see chapter 5.45.1, "Graphical Display, Explanation of the Elements", on page 552.



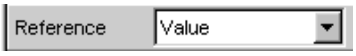
Some of the settings described below are only visible if the combined display is of adequate size on the screen. For example, scaling and grid lines are hidden automatically and stepwise if the display is reduced in size.

- **Unit of measurement result**
  This parameter field is used to set the unit for the measurement result display. The units available in the parameter list depend in the type of measurement.

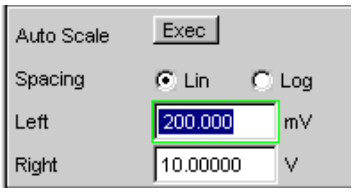
  An overview with all the units that occur for the audio analyzer and their conversion formulas is located in chapter 4.17, "Units", on page 173.
  Details concerning the numeric value display can be specified here for all linear units.
  For example, it is possible to select whether voltage is to be given in V, mV, µV, and so on. If "Auto" is set, these unit prefixes are automatically adapted to the measured value.

- **Reference values**

The reference value for relative measured values can be set here.
This can be a fixed preset value; however, values measured at a different location or values based on the generator settings and so on can also be adopted automatically as reference values.



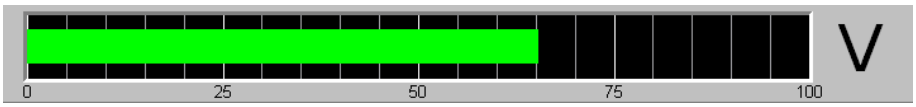
- **Bar graph scaling**
  If the "Autoscale" button is activated, the extreme values that have so far occurred are used for scaling the left-hand and right-hand scale end value. The scaling can, however, also be set manually.



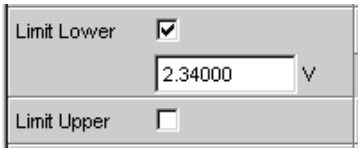
  The axis can be displayed with linear or logarithmic subdivisions.
  If manual scaling was selected, the start and end value of the bar graph must be entered in the two fields.
  If the selected scaling does not encompass all measured values, a red arrow indicates the end of the scale at which the measured value is beyond the range of the bar graph.

- Gridlines
  The settings Main Grid and Sub Grid are used to subdivide the bar graph.

  Main gridlines which are labeled with the associated numeric values can be added with different intervals.
  Subgridlines are used for further subdivisions; these lines are not labeled.

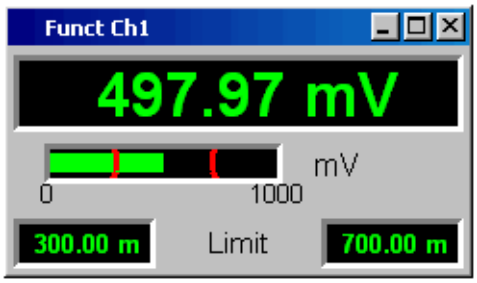


- Limits
  A lower and/or upper limit can be defined for each measurement result.
  If the limit is activated, each measured value is compared with the limit.

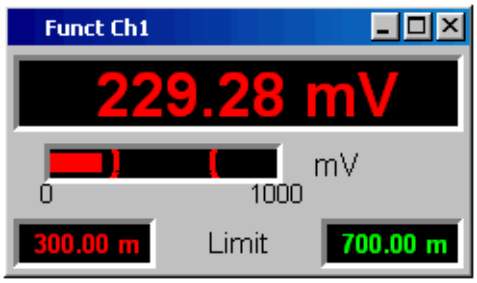


  The set limits are shown in the bottom part of the combined display and appear as a red limit marking on the bar graph.

As soon as one of the limits is exceeded, the measurement display and measurement bar changes from green to red. If the measured value is within the limits, the measurement display and measurement bar are displayed in green.



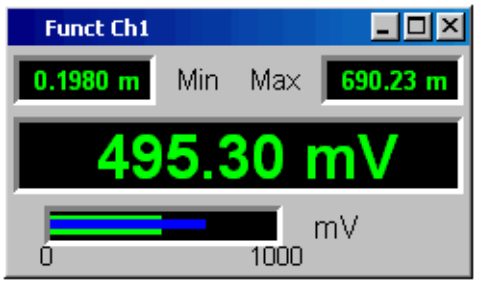
In order to monitor limit violations over a long period of time without having to watch the measurement displays continuously, the lower and/or upper limit is displayed permanently in red as soon as it is exceeded. Pressing the START key again or entering a new limit resets the limit to green.



The measurement display in the numeric display field always behaves in the same way as the measurement display in the combined field; current limit violations can therefore also be monitored in the numeric display field.

- Extreme values
  If this checkbox is activated, the lowest and highest measured value is displayed. Display of the Min/Max values can be set separately for each measurement display and for the two measurement channels.

  The minimum and maximum values which have been measured are shown in the top part of the combined display; an additional blue bar which records the span between the extreme values is also displayed.
  The Min/Max values can thus also be recorded over a long period of time without the measurement displays having to be monitored continuously.
  Pressing the START key again resets the Min/Max values.

- Number of displayed digits

The "Resolution" field is used to set the number of digits used when displaying the measured values, Min/Max values and limits.

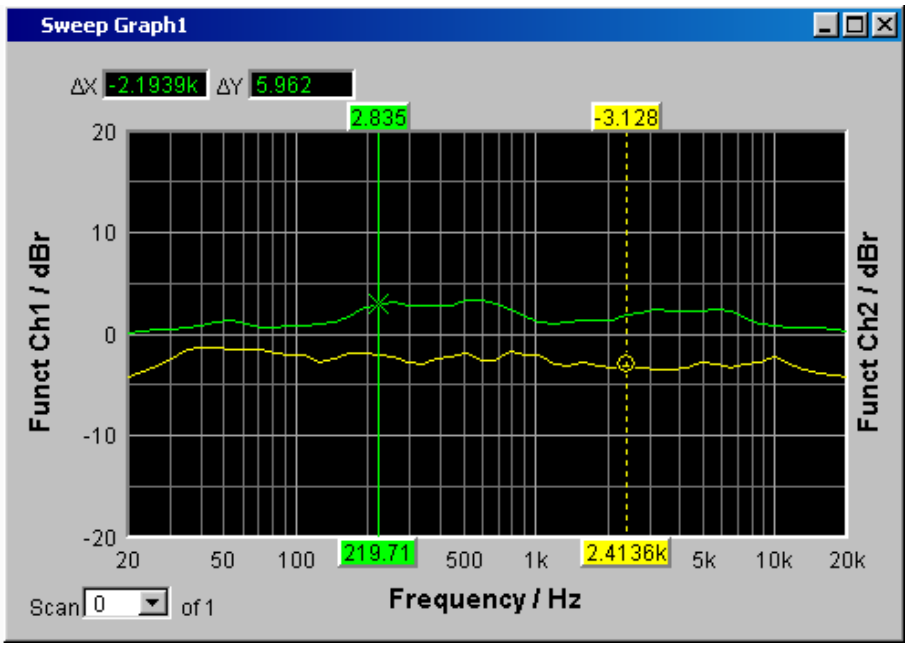
Values in linear units can be displayed with 3 to 7 digits; values in logarithmic units can be displayed with a resolution of 0.1 dB to 0.00001 dB.

4.8.4 Graphical window

The most informative method of displaying measurement results is usually a two-dimensional graphic. Measured values as a function of frequency, measurements over a time axis and so on are just a few examples of the many possible applications. The audio analyzer makes a distinction between the graphical windows (shown in the following sections) which can be set and modified using the associated configuration panels.

All graphical displays can be evaluated using horizontal and vertical cursors; markers are used to identify important measurement points. A broad range of softkey control functions can be used to scale graphs, to display sections of graphs, and to perform many other tasks.

4.8.4.1 Sweep graph

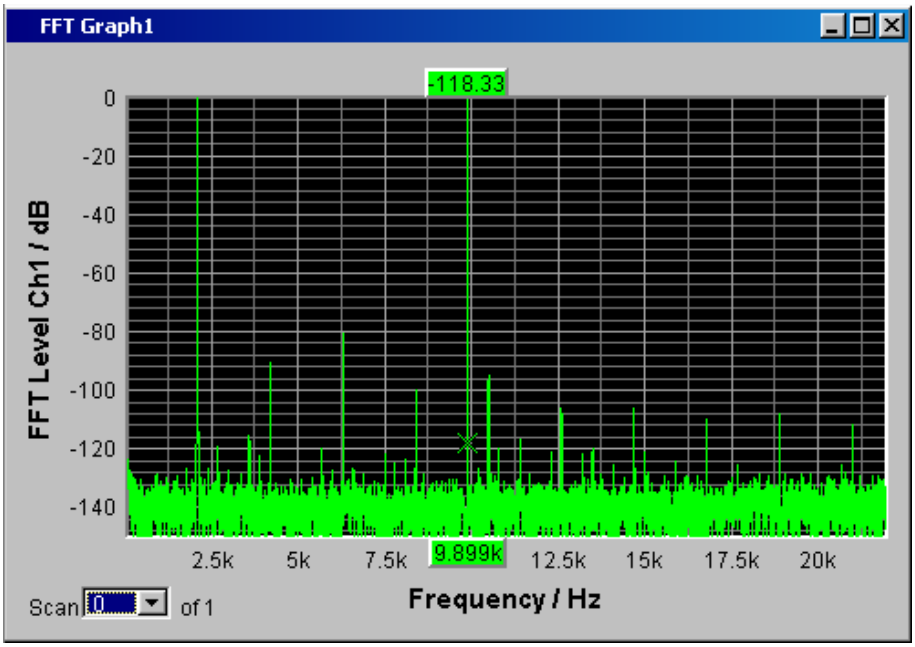


Here, the measured values of a measurement sequence (sweep) can be displayed as a line diagram in a coordinate system. One or two traces (TRACE A and TRACE B) can be recorded along an x-axis. Each trace can consist of a large number of scans.

The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

Up to four "sweep graphs" can be displayed at the same time and can all be configured differently. As a result, it is possible to display different measurement functions or display the same measurement function in a different way.

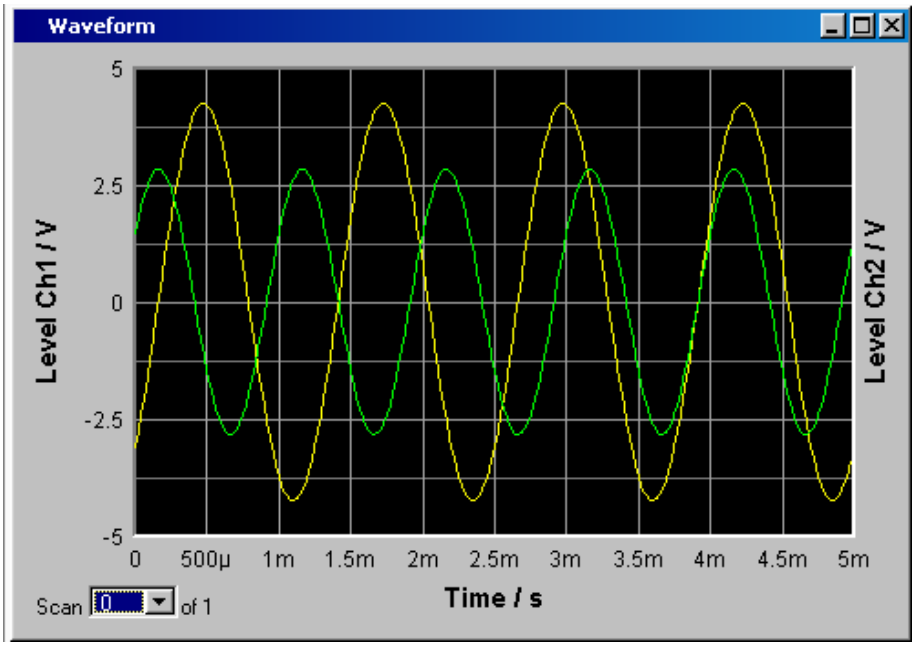
4.8.4.2 FFT Graph



In these panels, the frequency spectrum of the **FFT** measurement function or the **Post FFT** downstream of another measurement function. One or two traces (TRACE A and TRACE B) can be recorded along a frequency axis. Each trace can consist of a large number of scans. The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

Up to two FFT graphs can be displayed at the same time and can both be configured differently.

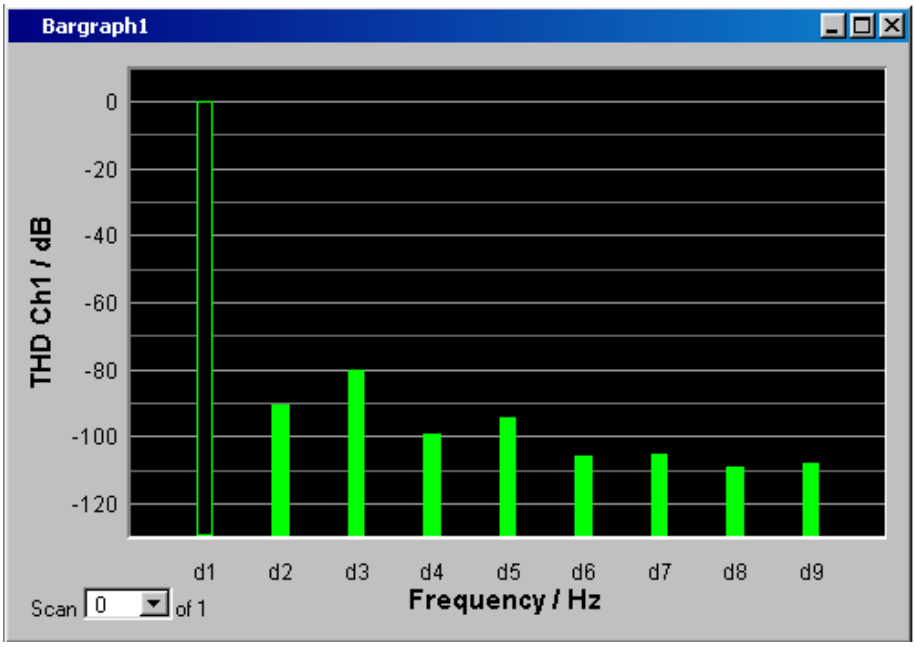
4.8.4.3 Waveform



The waveform display is a type of oscillogram in which the signal characteristic of the analyzed audio signal over time is displayed. One or two traces (TRACE A and TRACE B) can be recorded along a time axis. The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

This graph can be displayed once only; it is linked to the "Waveform" function in the "Analyzer Function" panel.

4.8.4.4 Bar Graph

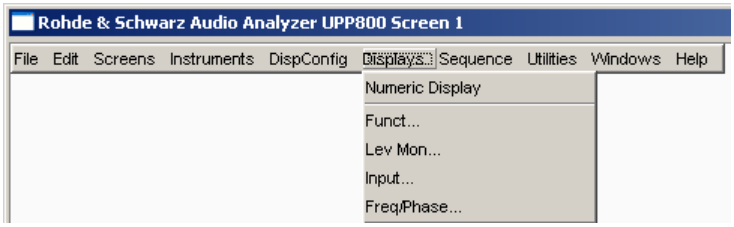


If one of the functions "THD", "Mod Dist" or "DFD" is selected in the "Analyzer Function" panel, the function measurement result can be displayed broken down into its frequency components on a bar graph. The individual distortion products are recorded along a frequency axis. The structure of the distortion products (2nd, 3rd, 4th, nth harmonic, DFD of 2nd or 3rd order, etc.) can be recognized at a glance. The bar graph can display one or two channels; once again, the results can be saved and saved results can be imported into the graph.

Two bar graphs are available so that, for example, THD values at two different measurement points can be displayed or the measured values of both input channels can be shown on two separate graphs.

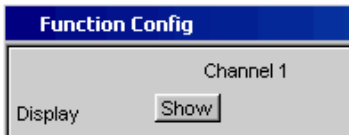
4.8.4.5 Opening graphical windows

The graphical windows can be opened via the menu bar; they are called up using the "Displays" button.



Depending on the channel number of the selected analyzer instrument, fonts and menu structure for "Display" Function, Lev Mon, Input, Frequency and Phase measurement results change.

Alternatively, the graphical windows can also be opened using the associated configuration panels (see the following section). The associated graphical window is activated using the "Show" button.



In the "Analyzer Function" panel, it is also possible to use the "Show" button to open some graphical or data windows. They will then be displayed in the same screen, without opening the associated configuration panels.

Function	PC keyboard	Mouse
Open graphical window via menu bar	Press the shortcut CTRL+M, then highlight the Displays button using the TAB or SHIFT+TAB keys, open the pulldown menu using the ENTER key, highlight the desired graphical window using the cursor keys and select it using the ENTER key.	Open the menu bar by moving to left edge of screen, activate the Displays button and click the desired graphical window.
Open graphical window via Config panel	Highlight the DISPLAY button in the associated Config panel and open the graphical window with the Enter key.	Click DISPLAY button in associated Config panel.
Open graphical window via Analyzer Function panel	Highlight SHOW button in Analyzer Function panel and open graphical window with ENTER key.	Click SHOW button in Analyzer Function panel.

4.8.4.6 Settings for measurement result display in the graphical windows

The associated panels for configuring the graphical windows are opened either using the "Disp Config" button in the menu bar or using the "Settings" softkey in the graphical window.

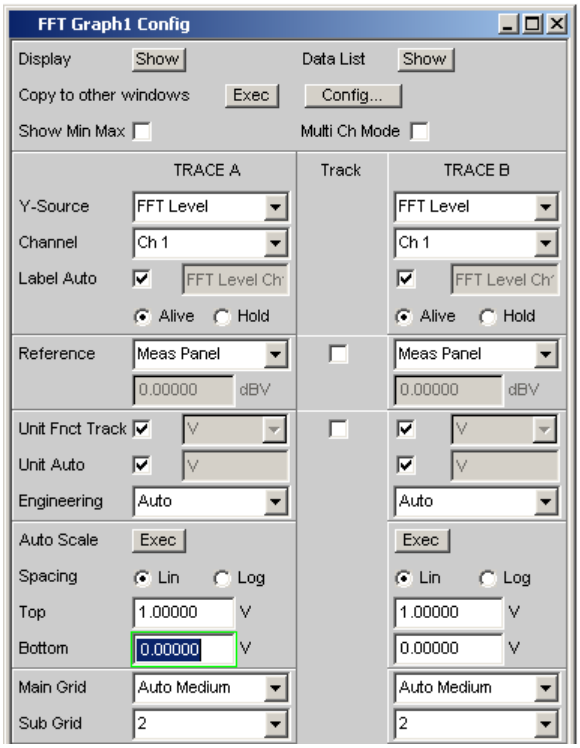
The settings for configuring the graphical displays are made in the following panels:

- Sweep Graph 1 to 4 Config
- FFT Graph 1 to 2 Config
- Waveform Config
- Bar Graph 1 to 2 Config

Function	PC keyboard	Mouse
Open panel for configuring a graphical window	Press shortcut CTRL + M, then highlight the Disp Config button using the TAB or SHIFT + TAB keys, open the pulldown menu using the Enter key, highlight the desired panel using the cursor keys and select using the Enter key.	Open the menu bar by moving to the left edge of the screen, activate the Disp Config button and click the desired panel.
Open panel for configuring a graphical window via softkeys in graphical window	Press F12 key for Settings softkey in respective graphical window.	Click Settings softkey in respective graphical window.

Some of the basic settings in these panels are described here using the "FFT Graph1 Config" panel as an example.

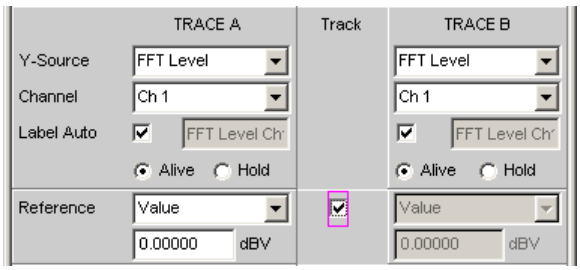
For a detailed description of the display options, see chapter 5.43, "Curve, Spectrum and Bar Graph Display", on page 476.



Some of the settings described below are only visible if the graphical window is of adequate size on the screen. For example, scaling and grid lines are hidden automatically and stepwise if the display is reduced in size.

Settings for the y-axis

All the panels used for configuring graphical windows have three columns.



In all graphical windows, two traces (TRACE A and TRACE B) can be recorded on y-axes along an x-axis. The "Y-Source" parameter field is used to determine which measurement functions are mapped to the y-axes. For multi-channel analyzer instruments, the input channel to be mapped can be selected using the "Channel" parameter field. In the sweep graphics, every trace can also consist of several individual traces (scans).

In many cases, settings are to apply to both traces. The track boxes provide multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameters having to be entered a second time.

If the track box is activated, all of the settings within the function group are applicable to both columns. All fields with applied settings are shown in the right-hand column as grayed out display fields. These fields cannot be accessed while the track function is active. If a setting is changed in the associated parameter field in the left-hand column, this change is also shown in the display field in the right-hand column.

Displayed values

The data which is to be graphically displayed can be determined for each trace. Usually this data comes from the selected measurement functions; however, saved data (reference data) can also be displayed.

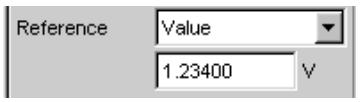
With Label Auto, the y-axis of the graph can be labeled with the data name selected under Source (see example below), or users can define their own label.

The "Hold" radio button is used to "freeze" the graphical display.

Additional scans can be added to a graph ("Append"), or existing scans in a graph can be replaced by new ones ("Replace").

Reference values

The reference value for relative measured values can be set here. This can be a fixed preset value; however, values measured at a different location or entire scans from files, from the other measurement channel and so on can also be used automatically as reference values / reference curves.



Units of Measured Values

This parameter field is used to set the unit for the trace. The units available in the parameter list depend in the type of measurement.

Alternatively, if the checkbox is selected, the unit used in the analyzer will be used.

An overview with all the units that occur for the audio analyzer and their conversion formulas is located in chapter 4.17, "Units", on page 173.

Details concerning the numeric value display can be specified here for all linear units.

For example, it is possible to select whether voltage is to be given in V, mV, µV, etc. If "Auto" is set, these unit prefixes are automatically adapted to the measured value.

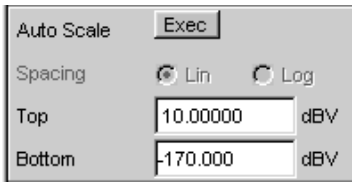
The used unit will appear on the y-axis of the graph (see example below). Sometimes it is better to use a label defined by the user; this label can be entered in the parameter field.

Y-axis scaling

If the button for automatic scaling is selected, the audio analyzer uses the minimum and maximum values of the available measurement cycle to automatically determine a suitable value range for the graph to be displayed. This scaling is determined once and retained until the autoscale function is triggered again.

If manual scaling is required, the upper and lower end value of the y-axis must be entered in the two fields.

If a linear unit has been selected for the y-axis, this axis can be displayed with linear or logarithmic subdivisions.



Gridlines

The settings Main Grid and Sub Grid are used to subdivide the bar graph.

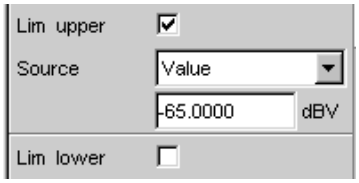
Main gridlines which are labeled with the associated numeric values can be added with different intervals.

Subgridlines are used for further subdivisions; these lines are not labeled.

Limits

A lower and/or upper limit can be defined for each measurement result.

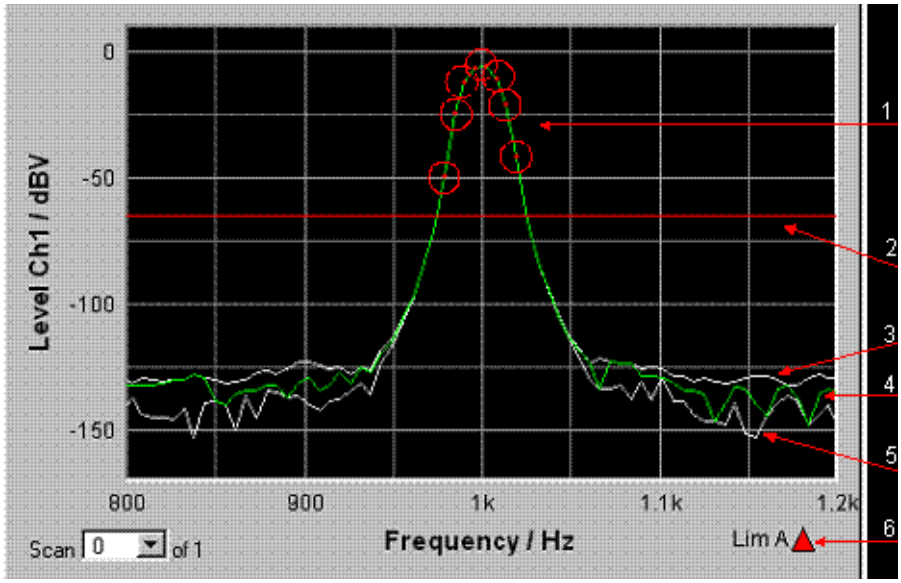
If the limit is activated, each measured value is compared with the limit.



Limit curves appear as a red line on the graph.

Each measured value which violates a limit is highlighted by a red dot on the curve. In addition, a red arrow pointing up/down in the bottom right-hand corner of the graph provides a permanent indication of limit overranging/underranging.

Every restart of a continuous measurement with START resets the limit monitoring again. Resetting the limit monitoring can also be done with the "Restart Min/Max, Lim Violation" softkey.



1 = Limit overshooting (here also marked with circles)
2 = Limit line
3 = Max value trace
4 = Trace
5 = Min value trace
6 = Limit display

Extreme values

If this checkbox is activated, a Min and Max characteristic is displayed that indicates the lowest and highest measurement results of a measuring sequence.

Two additional gray lines which represent the measured extreme values (see the example above) then appear in the graph.

The Min/Max values can thus also be recorded over a long period of time without the measurement displays having to be monitored continuously.

Every restart of a continuous measurement with START resets the limit monitoring again. Resetting the limit monitoring can also be done with the "Restart Min/Max, Lim Violation" softkey.

Settings for the x-axis

The same rules that apply to the y-axis also apply to the settings of the x-axis.

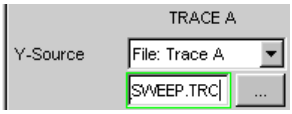
Display of X and Y Values

The "Resolution" field is used to set how many digits are used when displaying values on the x-axis and y-axis and at the cursor.

Values in linear units can be displayed with 3 to 7 digits; values in logarithmic units can be displayed with a resolution of 0.1 dB to 0.00001 dB.

Loading and saving traces / scans

The current trace together with all scans can be saved in these parameter fields by calling up the file directory using the ••• button; for details, see chapter 4.15, "File Management", on page 169.



Here, saved traces together with all of their scans can be loaded and displayed in the current graph by calling up the file directory using the ••• button.

4.8.4.7 Evaluating Graphical Displays with Cursors and Markers

All graphical displays can be evaluated using horizontal and vertical cursors; the X and Y-values shown in the display fields associated with the cursors are always current values.

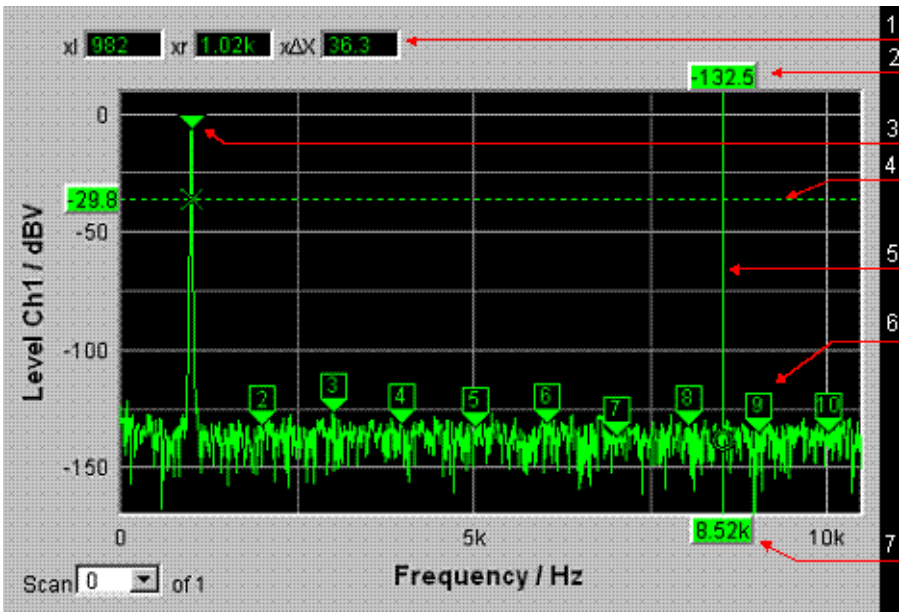
Markers are used to identify important measurement points.

The cursors and markers can only be operated using the softkey bar; the softkeys can be operated from the front panel, using the keys F5 to F12 on the external PC keyboard or by clicking with the mouse.

The graphics can be scaled or displayed zoomed in sections via softkeys or by using the mouse.

The basic settings in these functions are described here using examples.

For a detailed description of the display options, see chapter 5.43, "Curve, Spectrum and Bar Graph Display", on page 476.



1 = Additional cursor values
2 = Cursor Y value
3 = Marker
4 = Horizontal cursor
5 = Vertical cursor
6 = Harmonic marker
7 = Cursor X-value

As soon as the graphical window has the focus, the softkey bar for operating the graphical elements is shown at the bottom of the screen.

The softkeys are arranged in several levels; the lower levels are accessed by activating the respective button. Activating the "Back" button redisplays the higher level. At the lowest respective level, the buttons directly trigger the desired function.

Showing and hiding traces – Trace function

Activating the "Trace" button opens another softkey level.

Scaling graph – Autoscale function

Activating the "Autoscale" button opens another softkey level.

The softkeys available here are used to rescale the selected axes (if required, it is also possible to rescale the axes for certain traces only). The action triggered with these buttons corresponds to that of the "Auto Scale" or "Scaling Auto" button for the y or x-axis in the associated configuration panels. The "All" button scales x and y-axis simultaneously.

Operating the cursors

Activating the "Cursor" button displays the cursor softkeys:

The audio analyzer uses two cursors which are identified by the symbols O and X. These symbols indicate the measured point in the graph (see the example graph above).

Only one cursor is active and can be moved in the graph at any one time. The active cursor is displayed with a solid line; the inactive cursor is displayed with a broken line. The "O<->X" button alternately switches the O and X cursor. Alternatively, the ENTER key can also be used to switch between cursors.

The two buttons "O-Cursor" or "X-Cursor" activate the respective cursor and display the next softkey level.

The two buttons "Set O-Cursor" and "Set X-Cursor" open the next softkey level where the respective cursor can be set to certain values, e.g. maximum, minimum, etc.

If, for example, the cursor was activated with the "O-Cursor" button, the following softkeys appear:

For the "O Active" button, a softkey with an additional checkbox is used. The softkey indicates that the O-cursor is active and that further settings for this cursor are available under the adjacent softkeys. Activating/deactivating the checkbox shows/hides the cursor in the graph.

The two buttons "O Vert A" or "O Vert B" activate vertical cursors and place them on TRACE A or TRACE B. Both the cursor and its label fields are displayed in the color of the associated trace.

Activating the "O Vert A-B" button displays a gray cursor which represents the difference between the values for TRACE A and TRACE B.

The two buttons "O Hor A" or "O Hor B" activate horizontal cursors and place them on TRACE A or TRACE B. Both the cursor and its label fields are displayed in the color of the associated trace.

The "Movement" button leads to the next softkey level where you define how the cursor can be moved. The second line of the label shows the currently set step size in parentheses.

Moving the Cursor

Only one cursor is active and can be moved in the graph at any one time. The active cursor is displayed with a solid line; the inactive cursor is displayed with a broken line.

The "O<->X" button alternately switches the O and X cursor. Alternatively, the ENTER key can also be used to switch between cursors.

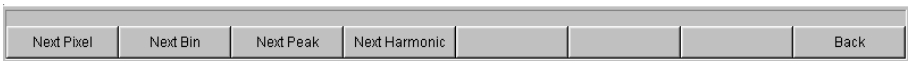
In the case of operation using the mouse, the desired cursor or one of its display fields can be activated and moved by simply clicking with the mouse.

A cursor can be moved in a number of different ways:

- On the external PC keyboard, the keys TAB / CTRL + TAB move the cursor to the right / left.
- In the case of operation using the mouse, the cursor can be clicked and moved by holding down the mouse key.

The step size with which a cursor is moved can be set using softkeys. To do so, the softkey of the desired O or X-cursor must first be selected:

The "Movement" button opens the next softkey level where various step sizes for moving the cursor are offered irrespective of the graph currently being used. This is described in greater detail below. The currently selected step size is indicated in brackets in the second label line of the "Movement" button.



Sweep graph

- **"Next Pixel "**
  Selecting the "Next Pixel" button moves the cursor by one pixel in the graphic with every increment. If there is not a measured value at every pixel in the graphical display (because only a few measurement points were recorded relative to the size of the displayed graph), the cursor value is interpolated linearly at the pixels between the measured values. If the number of recorded measurement points in the graph

is greater than the number of pixels available for display, the largest measured value in each case is displayed at the corresponding pixel with X and Y value.

- **"Next Step "**
  Selecting the "Next Step" button moves the cursor to the next measured value with every increment. The cursor is therefore moved in smaller or larger steps depending on the number of measurement points. If the graph is displayed relatively small or the number of recorded measured values displayed is greater than the number of pixels available in the graphical field, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.
- **"Next Peak "**
  Selecting the "Next Peak" button moves the cursor to the next measured peak with every increment.

FFT Graph

- **"Next Pixel "**
  Selecting the "Next Pixel" button moves the cursor by one pixel in the graphic with every increment.
  With FFT analyses, the number of recorded measurement points (bins) is usually much greater than the number of pixels available for display in the graph; the cursor then indicates the bin with the largest measured value at the pixel in question and displays this bin with its X and Y-values.
- **"Next Bin "**
  Selecting the "Next Bin" button moves the cursor to the next measured bin with every increment.
  Since with FFT analyses the number of recorded measurement points (bins) is usually much greater than the number of pixels available for display, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.
- **"Next Peak "**
  Selecting the "Next Peak" button moves the cursor to the next measured peak with every increment.
- **"Next Harmonic "**
  Selecting the "Next Harmonic" button moves the cursor to the next marked harmonic with every increment.
  This button is also available if the harmonic marker is not active (see the next section, Operating the markers). In this case, the button activates the harmonic marker.

Waveform

- **"Next Pixel "**
  Selecting the "Next Pixel" button moves the cursor by one pixel in the graphic with every increment.
  If there is not a measured value at every pixel in the graphical display (because only a few measurement points were recorded relative to the size of the displayed graph), the cursor value is interpolated linearly at the pixels between the measured values.

If the number of recorded measurement points in the graph is greater than the number of pixels available for display, the largest measured value in each case is displayed at the corresponding pixel with X and Y value.

- **"Next Sample "**
  Selecting the "Next Sample" button moves the cursor to the next measured value with every increment.
  If the graph is displayed relatively small or the number of recorded measured values (samples) displayed is greater than the number of pixels available in the graphical field, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.

Bar Graph

- **"Next Value "**
  Only the "Next Value" setting is available here; the cursor moves to the next measured distortion point (harmonic or intermodulation product) with each increment. The softkey movement indicates the step size.

All of the step-size settings for cursor movement described here only affect the currently selected cursor and are only applicable in the selected graphical window. This means that when a different cursor is activated or a different graphical window is selected, the cursor is moved using the settings applicable there.

The selected step size applies equally to vertical and horizontal cursors.

Function	PC keyboard	Mouse
Moving the Cursor	Activate desired cursor via softkeys and move using keys TAB and CTRL + TAB.	Click desired cursor or associated display field and move cursor with mouse key held down.
Select active cursor via softkey	Press the F5 function key of the "O<->X" softkey; this softkey toggles between O and X-cursor.	Click desired cursor or one of its display fields.
Select active cursor via Enter function	If desired graph has focus, Enter key toggles between both cursors.	Click desired cursor or one of its display fields.

Cursor in traces with several scans

If a trace consists of several scans, the cursors only move along one scan and indicate the x and y-values of this scan. The scan number displayed in the bottom left-hand corner of the graph in the respective display field indicates which scan is being analyzed.

In order to analyze individual scans with cursors, the cursor is switched to the desired scan in the following way:

- External PC keyboard: with the keys ALT + PAGE UP and ALT + PAGE DOWN
- Mouse: by clicking the "Scan" field shown above

Operating the markers

Activating the "Marker" button displays the marker softkeys:

The user must first select the trace on which a marker is to be set. The next softkey level appears simultaneously:

The two buttons **"Set to O-Curs"** and **"Set to X-Curs"** set the marker to the value of the currently selected cursor.

- **"Set to Value "**

Sets marker to a value that can be entered later in an input field that appears in the area of the softkeys

- **"Track to Max"**

sets a marker at the maximum value of the curve. If the maximum value changes, the marker is set at the new maximum value.

- **"Harm "**

marks harmonics of the frequency indicated by the marker.

If no marker has been set, activating the "Harmonics" button sets the marker to the maximum value of the trace and calculates and marks the harmonics from this frequency.

- **"Off"**

button deactivates the marker and the indication of the harmonics.

Zooming the graph

Activating the "Zoom" button displays the zoom functions.

- **"Act Curs In "**

The "Act Curs In" button zooms in on the section of graph on either side of the active X-cursor.

- **"Act Curs Out "**

The "Act Curs Out" button zooms out from the section of graph on either side of the active X-cursor.

- **"Betw V Curs"** or **"Betw H Curs"**

The "Betw V Curs" or "Betw H Curs" button zooms in on the area between the two X or Y-cursors. The zoomed display is fitted to the size of the set graph.

- **"Unzoom "**

The "Unzoom" button restores the original axis, i.e. undoes all of the zoom operations performed.

- **"Undo "**

The "Undo" button undoes the zoom operation last performed.

- **"Autoscale "**

The "Autoscale" button displays the next softkey level. The softkeys available here are used to rescale the selected axes (if required, it is also possible to rescale the axes for certain traces only). The initiated action corresponds to that of the "Autoscale "button in the corresponding configuration panel.

Restart Min/Max, Lim Viol function

Activating the "Restart Min/Max, Lim Violation" button displays another softkey level.

If the Show Min/Max function was selected in the associated configuration panel, activating the appropriate button in the softkey bar reactivates indication of the lowest and highest measured value.

If the Lim upper or Lim lower function was selected in the associated configuration panel, activating the appropriate button in the softkey bar reactivates limit monitoring.

Config function

The "Config" button allows the user to open or close the configuration panel while operating the associated graphical window.

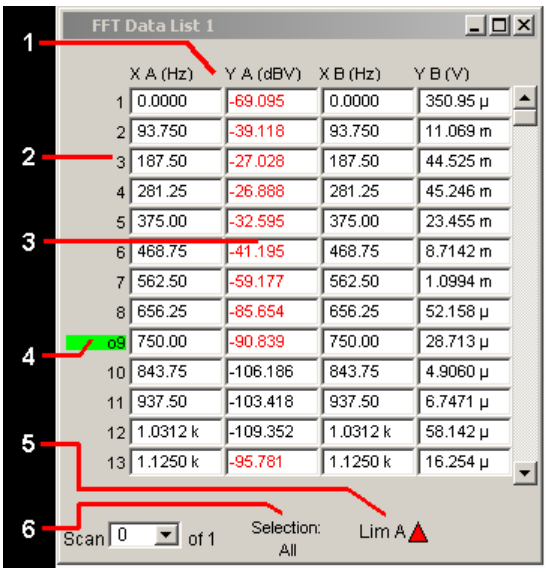
4.8.4.8 Measured value Display in Lists

The measured values can also be displayed in lists instead of or in combination with the graphical windows.

Measured values which have violated the preset limits are displayed in red.

In addition, a red arrow pointing up/down in the bottom right-hand corner of the graph provides a permanent indication of limit overranging/underranging.

Restarting a continuous measurement with START and activating the "Restart Min/Max, Lim Violation" button resets the limit monitoring.



1 = Columns with measured values
2 = Numbering of measured values
3 = Measured value with limit violation
4 = Cursor
5 = Display for limit violation
6 = Display filter

Open data list

Data lists can be opened via the corresponding configuration panels. The associated graphical window is activated with the "Data List Show" button.

Function	PC keyboard	Mouse
Open data list	Highlight Data List button in associated Config panel and open graphical window with Enter key.	Click Data List button in associated Config panel.

Data list settings

Function	PC keyboard	Mouse
Open panel for configuring a data list	Press shortcut CTRL + M, then highlight the Disp Config button using the TAB or SHIFT + TAB keys, open the pulldown menu using the Enter key, highlight the desired panel using the cursor keys and select using the Enter key.	Open the menu bar by moving to the left edge of the screen, activate the Disp Config button and click the desired panel.

For an in-depth description with the detailed options for the settings in these panels, see chapter 5.44, "Result List", on page 545.

A number of basic settings for the data lists are described here using examples.

The measured values displayed in the lists are always linked to the values in the result graphics. This means that all settings in the configuration panels, e.g. unit, engineering, set limits and so on, are also applied to the measured values in the lists.

The position of the cursor is also shown in the lists; the highlighted measurement number indicates the location of the cursor. Similarly, the step size of cursor movement set via the softkey bar (see the previous section) also affects the movement of the cursor in the data list.

Navigating in lists:

- If a mouse is used, you can either click the desired value or navigate using the scrollbar.
- As soon as a value has been highlighted in the list with the mouse (blue selection frame), the up/down cursor keys and the TAB/Shift+TAB keys allow navigating in the columns and the left/right cursor keys in the rows.

As soon as the data list has the focus, softkeys appear at the bottom of the screen.

The "Close" button closes the data list.

If the "Find Cursor" button is activated, the displayed section of the data list changes so that the value highlighted with the cursor is in the middle of the list. If both cursors are activated, this button is used to toggle between the two cursor values.

Using the "Selection" button, it is possible to filter the list of displayed measured values, i.e. to list only selected rows. If this button is activated, a further softkey level appears containing softkeys for selecting the displayed values:

Depending on the selected softkey, the following are listed in the data list:

- All
- only the values which exceed the upper, lower or both limits
- only harmonics or
- only peaks

Cursor in lists with several individual scans

If a trace consists of several scans, only the values of one scan can be displayed in the list at any one time. The scan number displayed in the bottom left-hand corner of the data list in the respective display field indicates which scan is entered in the list.

In order to list individual scans, the desired scan is selected in the following way:

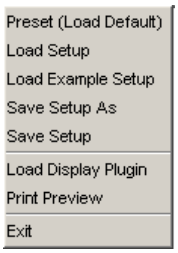
- External PC keyboard: with the keys ALT + PAGE UP and ALT + PAGE DOWN
- Mouse: by clicking the "Scan" field shown above

4.9 Settings in the Menu Bar

Rohde & Schwarz Audio Analyzer UPP800 Screen 1 D:\UPV\User\I2S.set
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help

The menu bar of the audio analyzer is used in a similar way to other Windows® applications. The following settings are made in the menu bar:

File



- **Preset (Load Default)**
  To load instrument default settings (see chapter 4.15.2, "Loading and Saving Instrument Settings", on page 170).
  A dialog box appears with the confirmation query: "Do you want to preset the device?"
  - **Yes**
    Preset is performed
  - **No**
    Cancel
  - **LAN Reset**
    Another confirmation query appears: "Do you really want to reset the LAN Settings? The settings will be set to DHCP + AutoIP / VXI-11 discovery on".
    Answering with "Yes" **resets the LXI LAN default settings**, loads the factory-preset **instrument default settings** and **restarts the instrumentv**.
- **Load Setup**
  To load device settings (corresponds to ALT+L on external keyboard).
- **Load Example Setup**
  To load instrument settings already prepared by Rohde & Schwarz for a broad range of typical measurements and available on the instrument as example applications; these setups are divided into various application areas (AA, AD, DD, DA) depending on whether the generator or analyzer is operated with analog or digital interfaces.
- **Save Setup As**
  To save instrument settings under a new name or to overwrite a setup that already exists (corresponds to ALT+S on external keyboard).
- **Load Display Plug-in**
  A plug-in can be selected here that expands the display options of UPP by additional panels, e.g. a spectrogram representation.
- **Print Preview**

A preview window of the current graphic is displayed here which is shown with the color profile configured for the respective output device. From here, the actual output can be initiated or the action can be canceled.

- **Exit**
  To exit the R&S UPP measurement program.

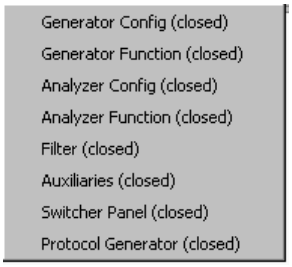
Edit

- **Cut**
  To cut characters, character strings, data, etc., and transfer them to the clipboard.
- **Copy**
  To copy characters, character strings, data, etc., to the clipboard.
- **Paste**
  To paste characters, character strings, data, etc., from the clipboard.
- **Select All**
  To select characters, character strings, data, etc., and transfer them to the clipboard.

Screens

- To select one of the five display options (screens), see chapter 4.4, "The Display", on page 110.

Instruments

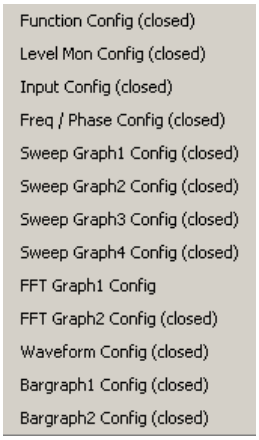


To select the panels for configuring the generators, analyzers, filters and supplementary functions.

- The desired panel must first be highlighted and is then displayed on the currently selected screen (see chapter 4.5.1, "Opening, Operating, Hiding and Closing Panels", on page 114)

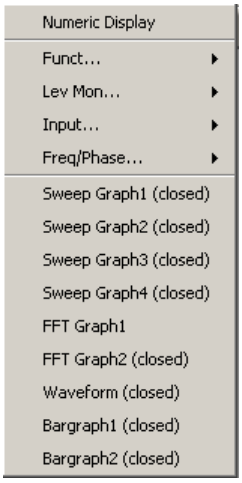
- In the list, open panels are displayed without a suffix, closed panels are identified by the suffix "closed", and open minimized panels by the suffix "hidden".

DispConfig



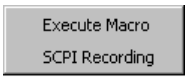
- To select the panel used to configure the measurement display windows.
- The desired panel must first be highlighted and is then displayed on the currently selected screen (see chapter 4.5.1, "Opening, Operating, Hiding and Closing Panels", on page 114)
- In the list, open panels are displayed without a suffix, closed panels are identified by the suffix "closed", and open minimized panels by the suffix "hidden".

Displays

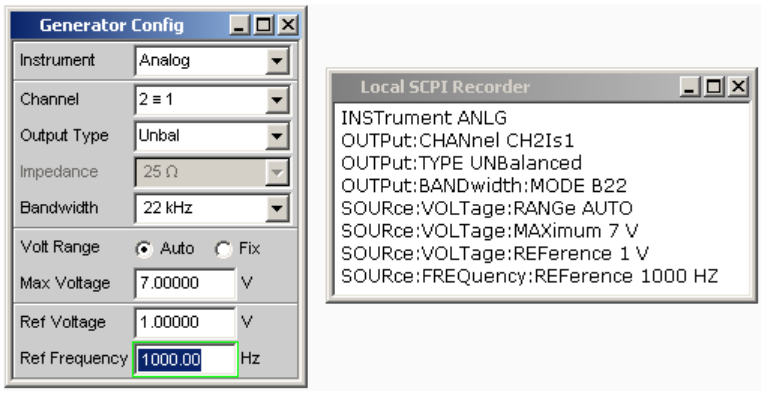


- To select the measurement display windows.
- The desired measurement window must first be highlighted and is then displayed on the currently selected screen (see chapter 4.5.1, "Opening, Operating, Hiding and Closing Panels", on page 114)
- In the list, open panels are displayed without a suffix, closed panels are identified by the suffix "closed", and open minimized panels by the suffix "hidden".

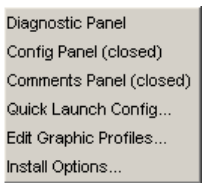
Sequence



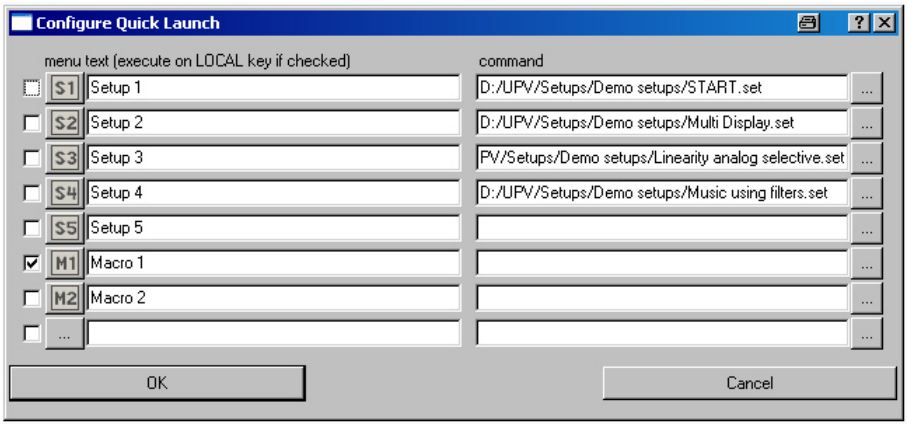
- **Execute Macro**
  To select sequences (macros) used to automate previously programmed measurement procedures to start.
- **SCPI Recording**
  Recording of remote control commands to simplify the creation of measurement programs (see chapter 6, "Remote Control - Fundamentals", on page 609)



Utilities



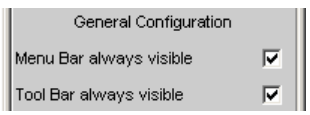
- **Diagnostic Panel**
  Opens a panel for entering service settings
- **Config panel**
  Opens a panel for entering instrument-wide settings, e.g. IEC bus address, the appearance of the file select box or whether the menu bar or toolbar is permanently displayed on the monitor.
- **Comments panel**
  Allows entering a comment for the current setup. This comment is stored in the setup and displayed again after reloading. A few style options are available for the entry and can be selected via the right mouse button.
- **Quick Launch Config ...**
  In the toolbar, you can define up to 8 icons that either load setups or execute macros when clicked with the mouse.
  You can determine these functions in the "Quick Launch Config…" window.



If a checkbox on the left side is enabled, the corresponding setup or macro is executed by means of the CTRL+F11 key on the front panel. If several checkboxes were enabled, the entries are processed from top to bottom.
Icons can be randomly defined by the user for the adjacent button column. You can do this by using the symbols (S1 to S8 or M1 to M8), which are standard on the instrument and can be found in the `C:\UPV\Config\res` directory.
However, you can also use any other icon. The only requirements are that the icon has a size of 20 x 20 pixels and that it is available as a BMP file on the hard disk of the audio analyzer.
Clicking the ... button with the mouse opens the File Selector, where you can select the icon file you want.
In the text lines, you can enter comments to describe the individual setup/macro.
In the command column, you can select the setup/macro that is to be activated with the symbol. The easiest way to do this is to click on the button with the mouse, whereupon the File Selector is opened, making it possible to select the required file.

- **Edit Graphic Profiles ...**
  Opens a window in which the current graphic is displayed with additional controls for editing the selected color profile. The line colors and types as well as the background colors can be set individually.
- **Install Options ...**
  Displays installed options and allows installing software options

Utilities Config panel, General Configuration settings



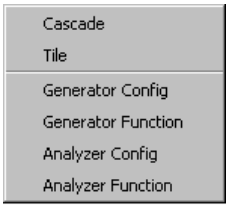
The R&S UPP allows you to have the menu bar and/or the toolbar displayed at the top edge or at the right-hand edge of the screen all the time. This feature is primarily for operation with the mouse.

- **Menu bar always visible**
  See "Menu bar always visible" on page 474

- **Toolbar always visible**

See "Toolbar always visible" on page 474

Windows



- **Cascade**
  To cascade all open panels / measurement windows.
- **Tile**
  To tile all open panels / windows.
- **Panel names**
  To display and select all panels and measurement windows which are open and displayed on the current screen. Selecting a panel moves it to the foreground.

Help

- **Contents**
  Calls up the help system of the audio analyzer, see chapter 4.14, "Help System", on page 166.
- **Index**
  Call up of the help system of the audio analyzer with an alphabetically sorted listing of all terms used in the help system.
- **About**
  To call up information about the firmware version installed on the instrument.

4.10 Settings on the Toolbar

Similar to other Windows® applications, the toolbar uses icons for the R&S UPP that execute functions if clicked on with the mouse. The following functions are offered:

Starts continuous measurements and sweeps.

Resets the Min/Max values for bar graph displays, averaging for measurement results, and limit overranging

Starts a single measurement or a single sweep

Measurement / sweep is stopped or continued (toggle function).

Depending on the settings under "Utilities" in the menu bar, "Config Panel" printout of the screen contents on the connected printer is started or the screen contents are stored in a file.

Switches all outputs of the measuring instrument off or on again (toggle function).

Opens a panel for loading predefined instrument settings

Opens a panel for storing instrument settings

Selects the appropriate display window (screen), where the colors used have the following meaning:

- The currently selected visible display window is indicated in green.
- All screens in which windows are activated are indicated in yellow.
- Blank display windows are indicated in gray.

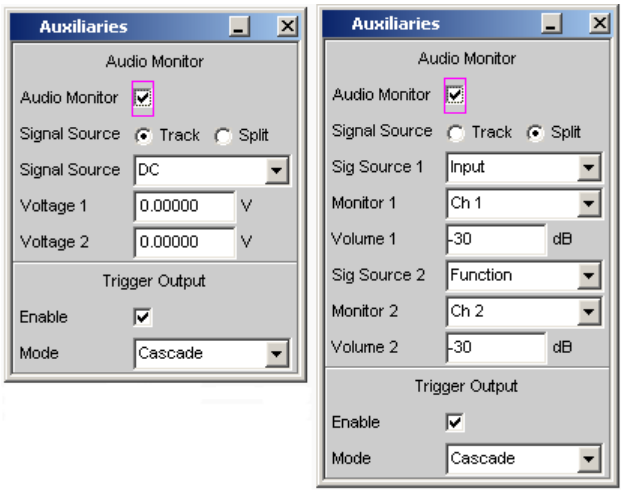
Symbols for conveniently loading predefined instrument settings or starting macros using the mouse. For the settings for this purpose, see chapter 4.9, "Settings in the Menu Bar", on page 158.

4.11 Settings in the Operating System

The R&S UPP is equipped with the Windows XP operating system. Settings at system level are only rarely required, e.g. installation of a new printer driver.

Connecting a keyboard and mouse makes Windows easier to use.

4.12 Auxiliaries Panel



In the "Auxiliaries" panel, the "Audio Monitor" add-on function can be selected for setting the monitor function for viewing analyzer signals and settings for the trigger output.

It is divided into the following sections:

- **Audio Monitor**, for configuring the audio-monitoring functions
- **Trigger Output**, for configuring the trigger output at the rear of the instrument

4.12.1 Audio Monitor Function

The monitor outputs (BNC sockets on the rear panel) permit the monitoring of analog or digital input signals (referred to as "Monitoring" in this document), both directly at the Audio Analyzer input and downstream of any filters that may be active. They also permit DC voltage output for supplying power to DUTs or external circuits.

The required settings are made in the Auxiliaries panel; the settings described here are intended as examples.

An in-depth description of the detailed options can be found in chapter 5, "Instrument Function", on page 185.

"Audio Monitor" switches the monitoring function on or off.

In the "Signal Source" Track / Split row, the "Signal Source" and output voltage at the monitor outputs ("Volume") can be selected for both monitor outputs together ("Track") or separately from each other ("Split").

The "Signal Source" field is used to select which signal is to be monitored. This can be the measurement signal switched to the analysis path either in the "Input" or "Function" level, i.e. with or without corresponding filtering. The individual levels of the analyzer are explained in greater detail in the section "Function blocks and measurement levels". Starting with serial numbers 120100, 140100, 180100, two DC voltages independent of each other in the range from -5 V to +5 V can be output.

The fields "Monitor 1" and "Monitor 2" are used to select which BNC socket is assigned to which measurement channel.

In the "Volume" field, the level at the BNC sockets is set by entering or changing the numeric value in the range from -120 dB to 120 dB.

The "Voltage" line sets the DC level at the BNC jacks.

Alternatively, CTRL+F9 of the external keyboard can be used to set the level at the BNC sockets. A window with a symbolized volume control opens which can be operated directly with the cursor keys or the mouse.

4.12.2 Trigger output

A trigger output for the following application is on the rear panel:

- **Gen Sync:** Output for a signal dependent on the start of the generator that can be used to trigger external instruments / circuits.
- **Cascade:** Reserved for later applications.

4.13 Rapid Deactivation of Outputs

CTRL+F12 of the external keyboard can be used in case of malfunctions to switch off the outputs of the generator.

The switched-off lines can be reactivated only by pressing CTRL+F12 again.

The switch-off of generator outputs is indicated by the **GEN OVLD** LED:

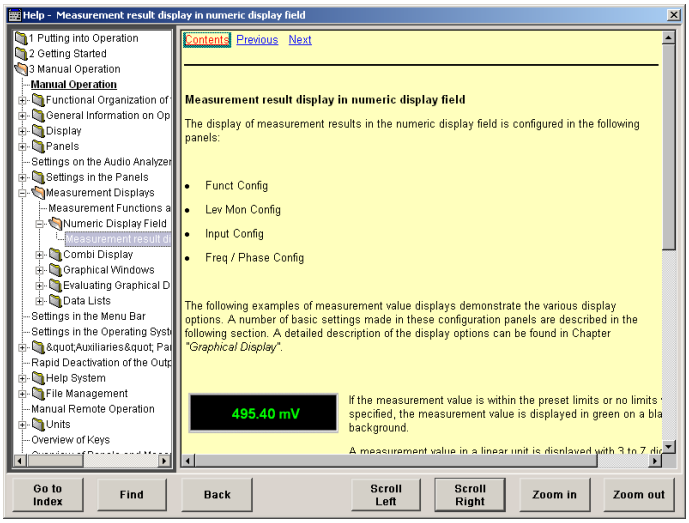
- **LED is yellow:** The generator outputs were switched off due to malfunctions or with CTRL+F12 of the external keyboard.
- **LED is red:** The generator outputs were overloaded by an external signal feed >= of approx. 12 V peak and switched off **at high impedance**.

Remote-control command:

`OUTPut` on page 690

4.14 Help System

The R&S UPP has a context-sensitive help system. The help system provides a help page for every parameter and can be called up at any time while the instrument is being operated. The help system has a navigation bar, i.e. starting from the context-sensitive page it is possible to move to other help pages using the contents list, the index, scroll arrows and page-internal links.


Help - Measurement result display in numeric display field
1 Putting into Operation
2 Getting Started
3 Manual Operation
Manual Operation
Functional Organization of
General Information on Op
Display
Panels
Settings on the Audio Analyzer
Settings in the Panels
Measurement Displays
Measurement Functions a
Numeric Display Field
Combi Display
Graphical Windows
Evaluating Graphical D
Data Lists
Settings in the Menu Bar
Settings in the Operating Syst
Rapid Deactivation of the Outp
Help System
File Management
Manual Remote Operation
Units
Overview of Keys
Contents Previous Next
Measurement result display in numeric display field
The display of measurement results in the numeric display field is configured in the following panels:
Funct Config
Lev Mon Config
Input Config
Freq / Phase Config
The following examples of measurement value displays demonstrate the various display options. A number of basic settings made in these configuration panels are described in the following section. A detailed description of the display options can be found in Chapter "Graphical Display".
495.40 mV
Go to Index
Find
Back
Scroll Left
Scroll Right
Zoom in
Zoom out

In addition to the context-sensitive help, a compiled online help for all functions of the R&S UPP is provided on the supplied CD. This help can be called up on any computer using the Internet Explorer (version 4.0 and higher).

4.14.1 Operating Help

The Help window is divided into three areas. On the left-hand side is a column that displays either the entire help contents list or the index. To the right of that is a large area showing the current help page and, if necessary, a vertical scrollbar. This area can also be moved up or down upon demand.

If the left-hand area containing the contents list or the index is activated, you can use the letter keys to go directly to the desired first letters in the area.

Click on the desired term with the mouse.

The bottom of the window contains several buttons for operating the help system. These buttons can be operated using the mouse or the buttons:

- **"Go to Index"**
  This button changes the display on the left-hand side to the index. You also use this button to return to the contents list; the button is then called "Go to Content".
- **"Find/Back"**
  If you navigate in the online help by activating links, activating this button returns you to the previous page.
- **"Scroll Left/Scroll Right"**
  Sometimes the help pages are too wide to fit completely in the display. In this case, a horizontal scrollbar is displayed. You can then use these buttons to scroll horizontally without losing the input focus.
- **"Zoom In / Zoom Out"**
  These keys enlarge / reduce the presentation of the help content.

The advantage of using these buttons is that the appropriate help area is always activated, allowing you to work smoothly.

4.14.2 Help Text Language

Both the context-sensitive help and the online help are available in English and German.

Function	PC keyboard	Mouse
Open help for a highlighted parameter field. Help page for selected parameter is displayed.	Press F1 key.	---
Close help	Press F1 key again.	---
Activate link Help opens linked page.	Highlight link using cursor keys and activate with Enter key.	Click link.
Scroll through help	Highlight Previous or Next in help window using cursor keys and activate with Enter key.	Click Previous or Next.
Change size of text	Use the F11 (Zoom In) and F12 (Zoom Out) keys to set the desired size.	Use the Zoom In and Zoom Out buttons to set the desired size.
Switch to index	F5 (Go to Index) key switches to index or back to contents list.	Go to Index button switches to index or back to contents list.
Scroll horizontally	Use the F9 (Scroll Left) and F10 (Scroll Right) keys.	Use the Scroll Left and Scroll Right buttons.
Select item from contents list Help page for selected item is displayed.	Highlight Focus button below contents list using cursor keys and activate with Enter key. Highlight desired item using cursor keys and then press Enter key.	Click item.

Function	PC keyboard	Mouse
Select index item Help page for selected item is displayed.	Highlight Focus button below index using cursor keys and activate with Enter key. Enter desired item in the entry field and press Enter key or Highlight entry with cursor keys and press the Enter key.	Click item.
Select help text language	Press shortcut CTRL+M, then highlight Utilities button using keys TAB or SHIFT+TAB, open pull-down menu with Enter key, highlight Config Panel button using cursor keys, select with Enter key and highlight desired language in Help Language item in next level using cursor keys and select with Enter key.	Click top of screen to open menu bar, activate Utilities button, click Config Panel button and click desired language in Help Language item in next level.

4.15 File Management

The R&S UPP uses files to store all instrument data, i.e. system and user data. User data includes stored instrument settings, data for equalizer files, lists for sweeps, and so on.

The files are stored on the instrument's hard disk. The `D:\` drive is available for storing user-defined data and can have any number of directory structures. A number of default directories are preconfigured; they can, however, be changed at any time.

Files can be transferred either using a USB stick or via a connected network.

The USB stick is inserted into one of the USB ports; a newly formatted stick receives the next available drive letter `E:\`.

In the case of a connected network, all network drives that can be accessed are available (see chapter 2.10.2.4, "Accessing directories in the network", on page 48).

The files are distinguished by their extension; each file type has a certain content. Normally, the extension is of no importance to the user since the files are accessed in the associated panels where only the relevant file type is available. For example, the files with equalizer settings can only be loaded in the "Generator Function" and "Analyzer Function" panels if the appropriate function settings have been made.

To load loaded settings or to store results, the "File Manager" must be called up using the ••• button in the respective panel and a File Select window appears.

4.15.1 Selecting the File Select Window

In the R&S UPP, you can select between two fundamentally different types of "File Select" windows. The desired style can be defined in the menu bar under the button

"Utilities", "Config Panel", section "General Configuration", parameter field"File Selector Win Style".

File Selector Win Style
Selects the style in which the "File Select" window is to be displayed.

See "File Selector Win Style " on page 475

4.15.2 Loading and Saving Instrument Settings

With the menu bar and the button "File", "Load Setup", "Load Example Setup", "Save Setup as", "Save Setup" or "Load Display Plug-in", the "File Select" window is called up.

Every R&S UPP audio analyzer has a range of instrument settings which have been prepared by Rohde & Schwarz for a broad selection of typical measurements and which are available on the instrument as sample setups. These setups are divided into different application areas (AA, AD, DD, DA), depending on whether generator or analyzer is operated with analog or digital interfaces, and are selected via the menu bar, "File" and "Load Example Setup".

This allows users to make settings for their own specific measurement tasks very simply by modifying these example setups.

All of these sample settings are located in the directory D:\UPV\Setup Examples.

Every R&S UPP also features the factory-based default instrument setting which can be called up directly via the menu bar, "File", "Preset (Load Default)".

4.15.3 List of File Extensions Used

File type	File extension	Meaning
Instrument settings	.SET	Setup file for saving and loading the instrument parameters set by the user ("complete" setup)
	.SAC	Setup file for saving and loading the instrument parameters set by the user ("current" setup)
Equalizer setting	.FTF	Amplitude/frequency table for noise generation in the frequency range
	.VEQ	Equalizer file; loaded in the "Equal File" parameter field of the Generator Function and Analyzer Function panels

File type	File extension	Meaning
Equalizer setting	.SWL	Sweep list for the following: Dwell times for automatic generator sweeps, loaded in the "Dwell File" field of the Generator Function panel Frequency of the generator or of the selective RMS measurement; loaded in the Generator Function panel ("Freq File", "Mean Freq File", "Upper Freq File" fields) or in the Analyzer Function panel ("File Name" field) Burst interval; loaded in the "Interval File" field of the Generator Function panel Burst duration; loaded in the Generator Function panel. On Time File menu item Generator voltage; loaded in the "Volt File" or "Tot Volt File" field (depending on the function) of the Generator Function panel
Files for data or limit lists	.LIM	Limit curve, loaded in the configuration panels for measurement windows under "Limit Upper" and "Limit Lower"
	.TRC	Trace lists for measured values, loaded in the configuration panels for measurement windows
Graphic files	.BMP	Pixel graphic
Other instrument files	.ARB	Time table for generating arbitrary signals
	.AWD	Timetable for generating arbitrary signals in the format of the output file of the Arbitrary Waveform Designer, which was used in the R&S UPL.
	.WAV	Standard format for audio signals to allow processing with PC sound cards
Filter files	.COE	Coefficient file for file-defined filters, loaded in the Filter panel in the "File Name" field
	.NPZ .XPZ .ZPZ	Pole/zero file for file-defined filters, loaded in the Filter panel in the "File Name" field
Audio files	.AC3	Audio file format for the Dolby Digital® (DD) multichannel sound system.
	.EC3	Audio file format for the Dolby Digital Plus® (DD+) multichannel sound system.

4.16 Manual Remote Operation

The R&S UPP permits manual remote operation using an external computer. As a result, the audio analyzer can be operated conveniently from the user's desk even if, for example, the audio analyzer is installed in a rack in a different room.

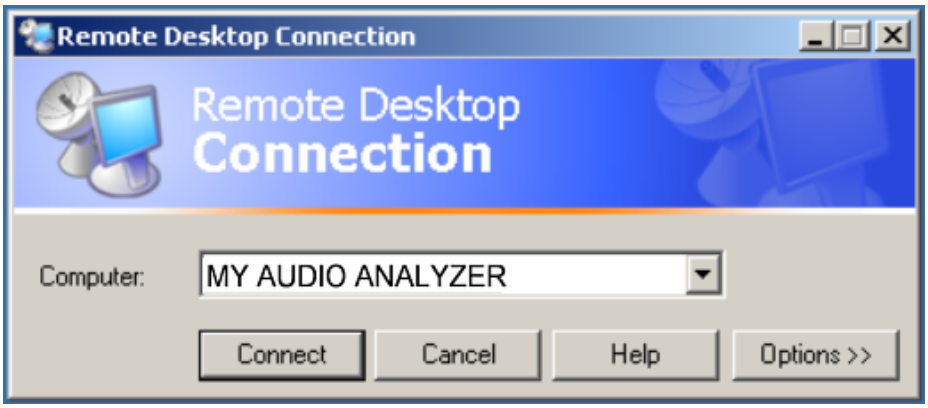
Unlike **remote operation** where remote-control commands are used, the **manual remote operation** requires separate Windows software which is installed on the external computer. When launched, the Windows software **Remote Desktop Connection**

simulates the user interface of the R&S UPP. This allows the instrument to be manually operated at the external computer in the same way as at the instrument itself.

Manual remote operation is only possible if the audio analyzer and computer are connected via LAN and the Windows software is installed on the computer.

Establishing the connection and installation of the remote-control software on the external PC is described in chapter 2.10.4, "Configuration for manual remote operation", on page 55.

Manual remote operation is started on the external computer by calling up the Remote Desktop Connection program and clicking on the Connect button. The R&S UPP must be selected as the remote operation device, i.e. its computer name must be displayed in the Computer: If the computer has been configured for remote operation of more than one instrument, the desired instrument can be selected from the list which is displayed by clicking the button. The user ID and password (**instrument** in both cases) can be stored when the software is first installed. The entry is possible in the expanded "Options>>" menu.



After logon, the instrument firmware of R&S UPP boots on the external computer. After the completion of the boot process, the screen of the audio analyzer appears and the R&S UPP can be manually remote-controlled from the external computer. The starting configuration is that which was active before the connection was set up. The individual functions are operated using the mouse and panel.

When establishing the connection, the instrument firmware at the R&S UPP is exited. During the manual remote control, it is not possible to perform any operations at the R&S UPP itself. Access by an external computer and the identity of the remote user is indicated on the login display of Windows.

To return to direct operation at the R&S UPP, it is necessary to log off the external user and log on the local user.

The external user can be logged off at the external computer in the "Start" menu of the R&S UPP window by clicking on "Disconnect" in the bottom right menu area.

Logging off is also possible directly at the R&S UPP in the remote control window.

The local user can be logged on at the R&S UPP in the remote control screen only after pressing the shortcut Ctrl + Alt + Del. By default, the R&S UPP uses **instrument** for this user name, and the password is also **instrument**.

After login, the instrument software starts with the settings used for manual remote operation.

4.17 Units

The R&S UPP features two types of units:

- **Units for measurement result display:**
  In the configuration panels for the measurement displays, a display unit must be selected for each measurement function. This unit is then used for the measurement result displayed in the measurement display windows. The unit is selected in the Unit fields of the respective panel.
- **Units for value entries** (e.g. reference values, frequencies, levels, etc.):
  When data is entered, the available units are displayed on the softkeys. This allows value entries to be adopted by selecting the unit without a further entry window having to be opened.

4.17.1 Units in Measurement Result Displays

To simplify matters: In the following conversion formulas, the entry values are designated by the unit only. Example: "dBu" means: value in "dBu".

4.17.1.1 Units for analog level measurement results

Basic unit: V

Value in	IEC/IEEE-bus notation	Conversion formula
V	V	
dBV	DBV	$20 \times \lg (V)$
dBu	DBU	$20 \times \lg (V/0.7745967)$
dBm	DBM	$10 \times \lg (V^2 \times 1000/R_{REF})$
W	W	V^2/R_{REF}
Δ%V	DPCTV	$(V/U_{REF}-1) \times 100$
ΔV	DV	$V-U_{REF}$
V/Vr	VVR	V/U_{REF}
%V/Vr	PCTVVR	$100 \times V/U_{REF}$
Δ%W	DPCTW	$(((V^2/R_{REF})-P_{REF}) \times 100)/P_{REF}$
ΔW	DW	$(V^2/R_{REF}) - P_{REF}$
P/Pr	PPR	$(V^2/R_{REF})/P_{REF}$
%P/Pr	PCTPPR	$(V^2/R_{REF})/P_{REF} \times 100$
dBr	DBR	$20 \times \lg (V/U_{REF})$

R_{REF} = Reference impedance (Ref Imped) from *Analyzer Config* panel

U_{REF} = Reference level (Reference) from *Config* panel for measurement function

P_{REF} = $(U_{REF})^2/R_{REF}$

4.17.1.2 Units for digital level measurement results

Basic unit: FS (Full Scale)

Value in	IEC/IEEE-bus notation	Conversion formula
FS	FS	
%FS	PCTFS	FS×100
dBFS	DBFS	20 × lg (FS)
Hex *)	HEX	FS × (2 Audiobits-1-1) for FS > 0 FS × (2 Audiobits-1-1) + (2 Audiobits-1) for FS < 0
Δ%	DPCT	(FS/U_{REF}-1) × 100
dBr	DBR	20 × lg (FS/U_{REF})
LSBs	LSBS	FS × 2 Audiobits-1
bits	BITS	1 + ld (FS × 2 Audiobits-1)

U_{REF} = Reference level (Reference) from *Config* panel for measurement function

*) Level measurement result in hex notation

All digital analyzer measurement functions usually deliver values ranging from 0 to 1 FS.

FS values >1 may occur in the following cases:

- In the case of the "Peak" measurement function with "Meas Mode" "Peak to Peak"
- In the case of a filter with gain (e.g. CCIR wtd) is used.

4.17.1.3 Units for distortion measurement results

Basic unit: %

Value in	IEC/IEEE-bus notation	Conversion formula
%	PCT	
dB	DB	20 × lg (% / 100)

In the case of SINAD: -20 × lg (% / 100)

4.17.1.4 Unit for S/N measurement results

Value in	IEC/IEEE-bus notation	Formula
dB	DB	20 × lg(S/N)

S: Measurement level with activated generator
N: Measurement level with deactivated generator

4.17.1.5 Units for frequency measurement results

Basic unit: Hz

Value in	IEC/IEEE-bus notation	Conversion formula
Hz	HZ	
ΔHz	DHZ	$Hz-F_{REF}$
Δ%Hz	DPCTHZ	$100 \times (Hz - F_{REF})/F_{REF}$
Toct *	TOCT	$lg\ (Hz/F_{REF}) \times 9.96578$
Oct	OCT	$lg\ (Hz/F_{REF}) \times 3.32193$
Dec	DEC	$lg\ (Hz/F_{REF})$
f/fr	FFR	Hz/F_{REF}

*) Toct = Third octave

F_{REF} = Reference frequency (Ref Freq) from *Freq Phase Config* panel for frequency measurement

4.17.1.6 Units for phase measurement results

Basic unit: ° (degrees)

Value in	IEC/IEEE-bus notation	Conversion formula
°	DEG	
RAD	RAD	$° \times \pi/180$
Δ°	DDEG	$° - P_{REF}$
ΔRAD	DRAD	$(° - P_{REF}) \times \pi/180$

P_{REF} = Reference phase (Ref Phase) from *Freq Phase Config* panel for phase measurement

4.17.1.7 Units for group delay measurement results

Basic unit: s

Value in	IEC/IEEE-bus notation	Conversion formula
s	S	
Δs	DS	$s - T_{REF}$

T_{REF} = Reference time (Ref Grp Del) from *Freq Phase Config* panel for group delay measurement

4.17.2 Units for Value Entries

To simplify matters: In the following conversion formulas, the entry values are designated by the unit only. Example: "dBu" means: value in "dBu".

Absolute analog level units (without reference)

Conversion formulae		IEC/IEEE-bus notation
V, mV, µV		V, MV, UV
Vpp, mVpp, µVpp (peak-to-peak voltage of signal)		VPP, MVPP, UVPP
dBu = 20 * lg (V/0.7746)	$V = 0.7746 * 10^{(dBu/20)}$	DBU
dBV = 20 * lg (V)	$V = 10^{(dBV/20)}$	DBV
dBm = 10 * lg (V^2 * 1000/R_{REF}) *)	$V = \sqrt{10^{(dBm/10)} \cdot R_{REF} / 1000}$	DBM
W = V^2/R_{REF}	$V = \sqrt{(W \cdot R_{REF})}$	W, MW, UW

R_{REF} = Reference impedance (Ref Imped) from the *Analyzer Config* panel

*) In the case of the generator, the reference impedance R_{REF} is always 600 Ohm. The IEC/IEEE-bus notation is DBMG. To calculate the open-circuit voltage Vo, the source impedance Rs (Impedance) from the *Generator Config* panel is also taken into account, which means that $V = Vo * R_{REF} / (Rs + R_{REF})$ is to be used in the above formula.

Relative analog level units (with reference)

Conversion formulae		IEC/IEEE-bus notation
$\Delta V = V - U_{REF}$	$V = \Delta V + U_{REF}$	DV, DMV, DUV
$\Delta\%V = (V/U_{REF} - 1) \times 100$	$V = U_{REF} \times (1 + \Delta\%V/100)$	DPCTV
$V/Vr = V/U_{REF}$	$V = V/V_r \times U_{REF}$	VVR
$dBr = 20 \times lg (V/U_{REF})$	$V = 10^{(dBr/20)} \times U_{REF}$	DBR
V/on= V/Burst amp[V]	V = V/on * Burst amp[V]	VON
%on = 100 * V/Burst amp[V]	V = %on * Burst amp[V]/100	PCTON
dBon= 20 * lg (V/Burst amp[V])	$V = 10^{(dBon/20)}$ * Burst amp[V]	DBON

U_{REF} = Reference level (Ref Voltage) in V from the *Generator Config* panel

Absolute digital level units (without reference)

Conversion formulae		IEC/IEEE-bus notation
FS		FS
bits = 1 + ld (FS × $2^{Audio\ bits-1}$)	FS = $2^{Bits-1} / 2^{Audio\ bits-1}$	BITS
%FS = 100 × FS	FS = %FS/100	PCTFS
dBFS = 20 × lg (FS)	$FS = 10^{(dBFS/20)}$	DBFS
LSBS = FS × $2^{Audio\ bits-1}$	FS = LSBS / $2^{Audio\ bits-1}$	LSBS

Relative digital level units (with reference)

Conversion formulae		IEC/IEEE-bus notation
$dBr = 20 \times lg (FS/U_{REF})$	$FS = 10^{(dBr/20)} \times U_{REF}$	DBR
$\Delta\% = 100 \times (FS/U_{REF} - 1)$	$FS = (\Delta\% / 100 + 1) \times U_{REF}$	DPCT
%on = 100 × FS/Burst amp[FS]	FS = %on × Burst amp[FS]/100	PCTON
dBon= 20 × lg (FS/Burst amp[FS])	$FS = 10^{(dBon/20)} \times$ Burst amp[FS]	DBON

U_{REF} = Reference level (Ref Voltage) in FS from the *Generator Config* panel

Absolute time units

Conversion formulae		IEC/IEEE-bus notation
s		S, MS, US
min = 60 s	s = min / 60	MIN
cyc = s * signal frequency	s = cyc / signal frequency	CYC, KCYC, MCYC

Absolute frequency units

Conversion formulae	IEC/IEEE-bus notation
Hz, kHz	HZ, KHZ

Relative frequency units (with reference)

Conversion formulae		IEC/IEEE-bus notation
$\Delta Hz = Hz - F_{REF}$	$Hz = \Delta Hz + F_{REF}$	DHZ, DKHZ
$f/fr = Hz/F_{REF}$	$Hz = f/fr \times F_{REF}$	FFR
$\Delta\%Hz = 100 \times (Hz - F_{REF})/F_{REF}$	$Hz = (\Delta\%Hz/100 + 1) \times F_{REF}$	DPCTHZ
$Toct = lg\ (Hz/F_{REF}) \times 9.96578$	$Hz = 2^{Toct/3} \times F_{REF}$	TOCT
$Oct = lg\ (Hz/F_{REF}) \times 3.32193$	$Hz = 2^{Oct} \times F_{REF}$	OCT
$Dec = lg\ (Hz/F_{REF})$	$Hz = 10^{Dec} \times F_{REF}$	DEC
(Toct = Third octave)		

F_{REF} = Reference frequency (Ref Frequency) from the *Generator Config* panel

Absolute phase units

Conversion formulae		IEC/IEEE-bus notation
°		DEG
rad = ° × (π/180)	° = rad × (180/π)	RAD

Deviations (tolerance) relative to previous measured values in settling function

Conversion formulae		IEC/IEEE-bus notation
$\% = (10^{dB/20} - 1) \times 100$	$dB = 20 \times lg\ (\%/100 + 1)$	DB, PCT

Step size of a logarithmic level sweep

Conversion formulae		IEC/IEEE-bus notation
$MLT = 10^{dB/20}$	$dB = 20 \times lg\ (MLT)$	[MLT], DB

Absolute resistance unit

Conversion formulae	IEC/IEEE-bus notation
Ω	OHM, KOHM

4.18 Overview of Keys

The following table provides an overview of the shortcuts of the PC keyboard and the mouse operation and its function.

Table 4-1: Softkeys

Key of the PC keyboard Operation with mouse	Function
F5 to F12	Triggers the function assigned to the softkey.

Table 4-2: CONTROL panel

Key of the PC keyboard Operation with mouse	Function
CTRL + F5	Starts continuous measurements and sweeps Resets the Min/Max values for bar graph displays, averaging for measurement results, and limit overranging
CTRL + F6	Starts a single measurement or a single sweep
CTRL + F7	Measurement / sweep is stopped or continued (toggle function)
CTRL + F8	Switches the loudspeaker or connected headphones on and off (toggle function)
CTRL + F9	Opens / closes the window for adjusting the audio monitoring volume
CTRL + P	Depending on the settings under Utilities, printout of the screen contents on the connected printer is started or the screen contents are stored in a file
CTRL + F10	Stores the current settings on the hard disk and then shuts down the Windows® operating system
CTRL + F11	Switches the instrument from remote operation to manual operation
CTRL + F12	Switches the outputs of the measuring instrument off or on again (toggle function)

Table 4-3: Navigation keys

Key of the PC keyboard Operation with mouse	Function
CTRL+PAGE UP / CTRL + PAGE DOWN	Switches to the previous / next display setting (screen)
CTRL+SHIFT+TAB (left) / CTRL+TAB (right)	Switches the focus to the previous / next panel open in the visible screen (the panel with the focus is active)
ALT+PAGE UP / ALT * PAGE DOWN	Changes to the previous / next scan in graphical displays so that, for example, measured values can be read off using the cursor
PAGE DOWN / PAGE UP	Scrolls to the next/previous page in tables

Table 4-4: Data entry keys

Key of the PC keyboard Operation with mouse	Function
1...9 a to z	Number entry: 1...9 Letter entry: a to z
0 SPACE	Number entry: 0 Entry of a space
. * ... #	Entry of a period / decimal point; Entry of special characters
- (SHIFT +) A to Z	Entry of sign; Switchover between uppercase and lowercase letters

Table 4-5: VARIATION panel

Key of the PC keyboard Operation with mouse	Function
CTRL + M	Displays the menu bar on the screen
BACKSPACE	Deletes the character to the left of the cursor Undoes the action last performed
ESC	Closes the open panel; the old value or parameter is retained
ENTER Left-click Turn mouse wheel	Completes the data entry (the new value is adopted); confirms and closes open entry windows
TAB (to the right) SHIFT+TAB (to the left) Turn mouse wheel	Moves the focus in the panels, selection windows and tables Varies the entry value at the cursor position Moves the active cursor in the graphical windows Switches the measuring steps forwards and backwards for manual sweeps
UP/DOWN cursor keys	Move the focus in the panels, selection windows and tables Change the entry value at the cursor position
LEFT/RIGHT cursor keys	Moves the active cursor inside the graphical windows Move the cursor position in entered values Switch the measuring steps forwards and backwards for manual sweeps

Table 4-6: WINDOW and SETUP panels

Key of the PC keyboard Operation with mouse	Function
ALT + W	Toggles between the softkey bar and the WINBAR
ALT + M	Opens a selection of functions on the softkey bar; these functions can be used to move or resize the active panel or graphical window
ALT + H	Minimizes ("hides") the active panel or graphical window

Key of the PC keyboard Operation with mouse	Function
ALT + C	Closes the active panel or graphical window
F1	Opens and closes the context-sensitive help function
ALT + S	Opens a panel for storing instrument settings
ALT + L	Opens a panel for loading predefined instrument settings
ALT + P	Loads the factory settings of the instrument

4.19 Overview of Panels and Measurement Displays (Graphical Windows)

Panels which can be selected via the Instruments menu bar button:

Generator Config	• Selection of instrument (analog or digital interfaces) • Configuration of channels • Bandwidth and sampling rate • Reference values • Synchronization settings and word length (for digital interfaces)
Generator Function	• Selection of test signals • Sweep function • Frequency and level settings • Filter and equalizer
Analyzer Config	• Selection of instrument (analog or digital interfaces) • Configuration of channels • Measurement bandwidth and sampling rate • Reference impedance • Start and trigger conditions
Analyzer Function	• Selection of measurement functions • Measurement speed and accuracy • Activation of filter and equalizer • Activation of Post FFT • Selection and settings for level monitor • Selection and settings for input monitor • Selection and settings for frequency, phase, group delay measurement • Selection and settings for waveform monitor
Filter	• Definition of filter properties
Auxiliaries	Audio Monitor • Settings for the two BNC monitor sockets at the rear of the instrument • Switch-on/switch-off function • Signal source and channels • Output level

Switcher Panel	• Function settings and operation of one or more connected Audio Switchers R&S UPZ. At the UPP, the switcher is connected via a USB-to-serial adapter which is mapped to an open COM port by Windows. This port is also indicated in the panel.
Protocol Generator	• Settings for the generator functions for generating the digital audio protocol of the R&S UPP B2 option (digital audio interfaces).

Panels which can be selected via the Disp Config menu bar button

Function Config	• Settings for measured values of active measurement function in numeric display field • Settings for associated combo displays • Settings for limits, minimum values and maximum values
Level Monitor Config	• Settings for numeric measured values of level monitor in numeric display field • Settings for associated combo displays • Settings for limits, minimum values and maximum values
Input Config	• Settings for measured values of input monitor in numeric display field • Settings for associated combo displays • Settings for limits, minimum values and maximum values
Freq Phase Config	• Settings for measured values of frequency, phase and group delay measurement in numeric display field • Settings for associated combo displays • Settings for limits, minimum values and maximum values
Sweep Graph 1 to 4 Config	• Four of these panels are available so that up to 4 sweep graphical windows can be displayed simultaneously • Setting of all details for one-channel or two-channel graphical display of sweep functions, e.g. units, scaling, gridlines, etc. • Evaluation of minimum and maximum values • Entry of limit curves • Settings for cursors and markers
FFT Graph 1 to 2 Config	• Two of these panels are available so that up to 2 FFT graphical windows can be displayed simultaneously • Setting of all details for one-channel or two-channel display of FFT graph, e.g. units, scaling, gridlines, etc. • Evaluation of minimum and maximum values • Entry of limit curves • Settings for cursors and markers
Waveform Config	• Setting of all details for graphical display of waveform analyzer, e.g. number of curves, units, scaling, gridlines, etc. • Entry of limit curves • Settings for cursors and markers
Bar Graph 1 to 2 Config	• Two of these panels are available so that up to 2 bar graph windows can be displayed simultaneously • Setting of all details for one-channel or two-channel display of bar graphs, e.g. units, scaling, gridlines, etc. • Evaluation of minimum and maximum values • Entry of limits • Settings for cursors and markers

Measurement windows which can be selected via the Displays menu bar button:

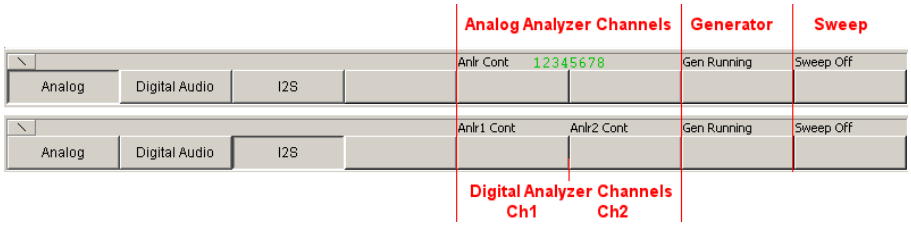
Numeric Display	• Display of measurement results for measurement function selected in the "Analyzer Function" panel • Display of measurement results for level monitor selected in the "Analyzer Function" panel • Display of measurement results for input monitor selected in the "Analyzer Function" panel • Display of frequency measurement results or frequency measurement result and phase or group delay measurement results • The measurement results are displayed in the way defined in the configuration panel
Funct Ch1 to 2 Funct ...	• These combo displays are extensions to the numeric measurement displays of the measurement function selected in the "Analyzer Function" panel; they show the respective numeric value plus the following additional features: • Analog bar graphs • Monitoring and display of limits • Storage of minimum and maximum values • The measurement results are displayed in the way defined in the configuration panel
Lev Mon Ch1 to 2 Lev Mon ...	• These combo displays are extensions to the numeric measurement display of the level monitor selected in the "Analyzer Function" panel; they show the respective numeric value plus the following additional features: • Analog bar graphs • Monitoring and display of limits • Storage of minimum and maximum values • The measurement results are displayed in the way defined in the configuration panel
Input Ch1 to Ch2 Input ...	• These combo displays are extensions to the numeric measurement display of the input monitor selected in the "Analyzer Function" panel; they show the respective numeric value plus the following additional features: • Analog bar graphs • Monitoring and display of limits • Storage of minimum and maximum values • The measurement results are displayed in the way defined in the configuration panel
Freq Ch1 Phase Ch2/Ch1 Freq/Phase ...	• These combo displays are extensions to the numeric measurement display of the frequency/phase measurement selected in the "Analyzer Function" panel; they show the respective numeric value plus the following additional features • Analog bar graphs • Monitoring and display of limits • Storage of minimum and maximum values • The measurement results are displayed in the way defined in the configuration panel
Sweep Graph 1 to 4	• Up to four of these display windows can be open simultaneously to display scans from sweep measurements • One-channel or two-channel graphical display • The measurement results are displayed in the way defined in the respective "Sweep Graph 1 to 4 Config" configuration panel
FFT Graph 1 to 2	• Up to two of these display windows can be open simultaneously to display the FFT analyses of the selected measurement function or of the Post FFT • One-channel or two-channel graphical display • The measurement results are displayed in the way defined in the respective "FFT Graph 1 to 2 Config" configuration panel

Waveform	• This display window shows the characteristic of the measurement signal over time • One-channel or two-channel graphical display • The measurement results are displayed in the way defined in the "Waveform Config" configuration panel
Bar Graph 1 to 2	• Up to two of these display windows can be opened to display bar graphs of the selected measurement function • One-channel or two-channel graphical display • The measurement results are displayed in the manner defined in the respective "Bar Graph 1 to 2 Config "configuration panel

4.20 Overview of Status Messages

The status of the R&S UPP is continuously displayed for the generator, analyzer, sweep system and other instrument states at the bottom of the screen in four fields above the four right-hand softkeys.

Status displays always appear at the same position; they are assigned to the fields above the softkeys as shown below.



The following overview shows the possible status messages and their meaning:

Analyzer status - Status information for the channels Anlr

For the UPP, the status displays of the channels are compressed to one row with a character coding. One character corresponds to each channel viewed from left to right, whereby a switched-off channel is marked with a black line, a switched-on channel with the respective number in green. The conditions Overrange and Underrange are indicated by a color marking (red or black)

Status display for channel	
-	Measurement channel is deactivated
Number in green	Measurement channel is correctly modulated
Number in red	Measuring range has been overranged; this can occur if: • Range Fix setting is being used • A signal with a level at range limit is applied with a crest factor > 2 • Common-mode voltage is applied in BAL input configuration
Number in black	Measuring range has been underranged; this can occur if Range Fix or Lowest setting is being used
Other status display	
Single	Single measurement is being performed

Cont	Continuous measurement is being performed
Terminated	Single measurement has been terminated
Stopped	Measurement has been stopped
Wait for Trigger	Analyzer is waiting for set trigger condition

Generator status

Gen Off	Generator is deactivated
Gen Running	Generator signals are being output
Output Off	All output lines are deactivated
Gen Overload	Generator has been deactivated owing to overload

Sweep status

Sweep Off	No sweep is being performed
Sweep Waiting	Sweep has been defined but not yet started
Sweep Terminated	Single sweep has been terminated
Sweep Stopped	Sweep has been stopped but can be continued
Sweep Run Cont	Continuous sweep is being performed
Sweep Run Single	Single sweep is being performed
Sweep Run Manual	Manual sweep is being performed

5 Instrument Function

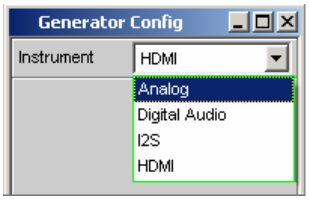
5.1 Selecting the Generator

5.1.1 Generator Configuration Panel

The Configuration panel allows settings for the analog and digital generators.

To adapt the R&S UPP generator to the measurement task at hand, first define the settings in the Generator Config panel. These settings will determine which capabilities are available in the Generator Function panel.

Instrument
Used to select the generator.



"Analog" Select analog 2-channel generator
The user has access to a universal generator for almost any signal form (up to 80 kHz).
If the option R&S UPP B8 (multichannel audio generator) is installed, 8 channels are available whose signals can be set individually for each channel using the "Universal" generator function.

"Digital Audio" Select digital audio generator.
Generating audio data in AES/EBU or SPDIF format.

"I²S" Select I²S generator
The I²S generator can generate audio data in I²S format.

"HDMI" Select HDMI generator
The HDMI generator can be used to output video and audio data according to the HDMI 1.4 standard. In addition, the generation of HDMI-specific info frames and protocol data is supported.

Remote command:
`INSTrument<n1>` on page 659

5.2 Configuring Analog Generator

5.2.1 Analog Generator Config Panel

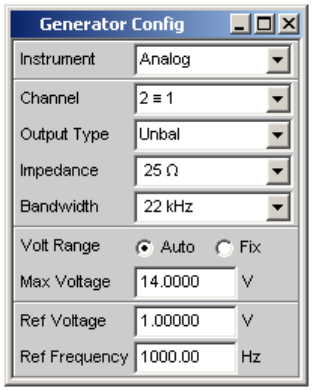


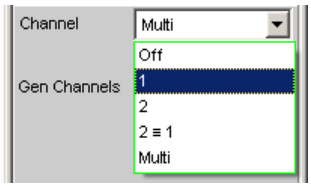
Fig. 5-1: Analog generator configuration panel

The "Analog" generator instrument does not require any options for 2-channel generation and requires the R&S UPP B8 option (multichannel audio generator) for the eight-channel generation.

The configuration options for the analog generator are described below.

Channel
Select the XLR **plugs** for the signal path on the bottom right front side of the R&S UPP.

Select the channels on the 25-pin D-Sub socket with the setting "Multi", if the R&S UPP B8 option (multichannel audio generator) is installed.

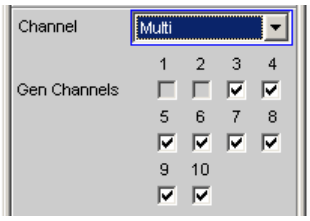


"OFF"	Both XLR plugs are deactivated.
"1"	XLR plug 1 supplies the generator signal; XLR plug 2 is deactivated.
"2"	XLR plug 2 supplies the generator signal; XLR plug 1 is deactivated.
"2 = 1"	Both XLR plugs supply an output signal. **Note:** If the generator function Stereo Sine is selected, the output signal may differ with regard to level and frequency.

"Multi" Opens a free selection option of up to 8 generator channels, if the R&S UPP B8 option (multichannel audio generator) is installed. With the "Universal" generator function, the signals can be set individually for each channel.
The multichannel generator outputs are configured asymmetrically. The output impedance is fixed at 25 Ω.
The eight generator outputs of the UPP B8 are available at the pins of a 25-pin D-Sub socket.
Interface assignment, output and output power of the analog multichannel generator, see chapter 5.2.4, "Interface Assignment of the Analog Multichannel Generator", on page 193

Remote command:
OUTPut:CHANnel on page 661

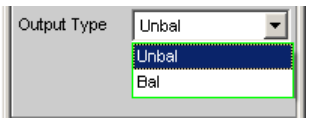
Gen Channels
Setting of the respectively active generator channel.



The free selection of channels 3 to 10 is offered if the R&S UPP B8 (multichannel audio generator) is installed and "Multi" was selected in the parameter field. The eight generator outputs are labeled Ch3 to Ch10 to prevent mixups with channels 1 and 2 of the universal generator.

Remote command:
OUTPut:MCHannels<n2> on page 664

Output Type
The generator output can be configured as asymmetrical (Unbal) or symmetrical (Bal). The setting always applies to both outputs.



If the eight-channel generator is used, the generator outputs are set permanently to asymmetrical (Unbal) and the line is disabled.

"Unbal" The average value of the generator signal can be max. 7 V.
To be able to work with commercially available BNC cables, we recommend using an R&S UP-Z1F XLR/BNC adapter.

"Bal" The average value of the generator signal can be max. 14 V.

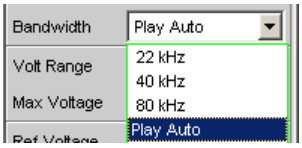
Remote command:
OUTPut:TYPE on page 661

Impedance
Starting with serial numbers 120100, 140100, 180100, an output impedance of either 25 Ω or 600 Ω can be set in this field, previously 25 Ω were permanently set.

If the eight-channel generator is used, the output impedance of the generator outputs is set permanently to 25 Ω.

Remote command:
`OUTPut:IMPedance` on page 661
`OUTPut:IMPedance:UNBalanced?` on page 662

Bandwidth
When you choose the universal generator you can set three different fixed frequency ranges and one signal-dependent sampling frequency.



"22 kHz" The maximum output frequency is 21.75 kHz. The generator DAC is clocked at 48 kHz.

"40 kHz" The maximum output frequency is 40 kHz. The generator DAC is clocked at 96 kHz.

"80 kHz" The maximum output frequency is 80 kHz. The generator DAC is clocked at 192 kHz.

"Play Auto" For the Play generator function only. The bandwidth is automatically determined as a function of the sample rate entered in the WAV file. This sample rate is likewise used for clocking the generator DAC.

Remote command:
`OUTPut:BANDwidth:MODE` on page 660

Volt Range
Two different modes are available for generator level control.

"Auto" The internal signal paths are optimally driven; the output voltage is adjusted using the analog hardware.
Advantage:
Optimum noise and distortion values.

"Fix" The analog hardware is permanently set to the specified maximum voltage. The actual output voltage is obtained by controlling the level of the D/A converter; the analog hardware settings remain unchanged.
Advantage:
Faster level changes and better settling. Voltage dips when switching over the attenuator are avoided as no relays are connected.

Note: If the Volt Range = Fix setting is chosen for the signal to noise measurement, the generator level does indeed oscillate more rapidly, but in certain cases the lowest possible noise level may not be obtained. This restricts the dynamic range of the signal to noise measurement.

Remote command:
`SOURce:VOLTage:RANGe` on page 661

Max Voltage
Maximum value for the output voltage; prevents excessively high voltage values from being entered inadvertently in the Generator Function panel.

It is not possible to configure a higher voltage in the Generator Function panel than the one specified here.

The average value for sinusoidal signals is entered, i.e. the maximum peak value is higher by a factor of $\sqrt{2}$.

Remote command:
`SOURce:VOLTage:MAXimum` on page 661

Ref Voltage
Reference value for the relative voltage units.

If the reference level is changed, all voltage settings linked to the reference value also change.

The relative voltage of the generator signal remains unchanged.

By varying the reference voltage, a level sweep defined with relative start and stop levels, for example, can be shifted by a constant "gain factor".

Remote command:
`SOURce:VOLTage:REFerence` on page 660

Ref Frequency
Reference value for the relative frequency units.

If the reference frequency is changed, all frequency settings linked to the reference value also change.

The relative frequency of the generator signal remains unchanged. By varying the reference frequency, the fundamental of a distortion spectrum set using a multi-sine wave, for example, can thus be shifted without the harmonics having to be calculated and set again by the user.

Remote command:
`SOURce:FREQuency:REFerence` on page 660

5.2.2 Outputs of the universal generator

The outputs of the analog R&S UPP generator can be configured in various ways with regard to Channel and Output Type (see previous chapter). Starting with serial numbers 120100, 140100, 180100, the output impedance can be switched between 25 Ω and 600 Ω; previously, 25 Ω were permanently set. The schematic circuit diagram for the generator output is shown below.

Unbalanced Output (Output Type "Unbal")

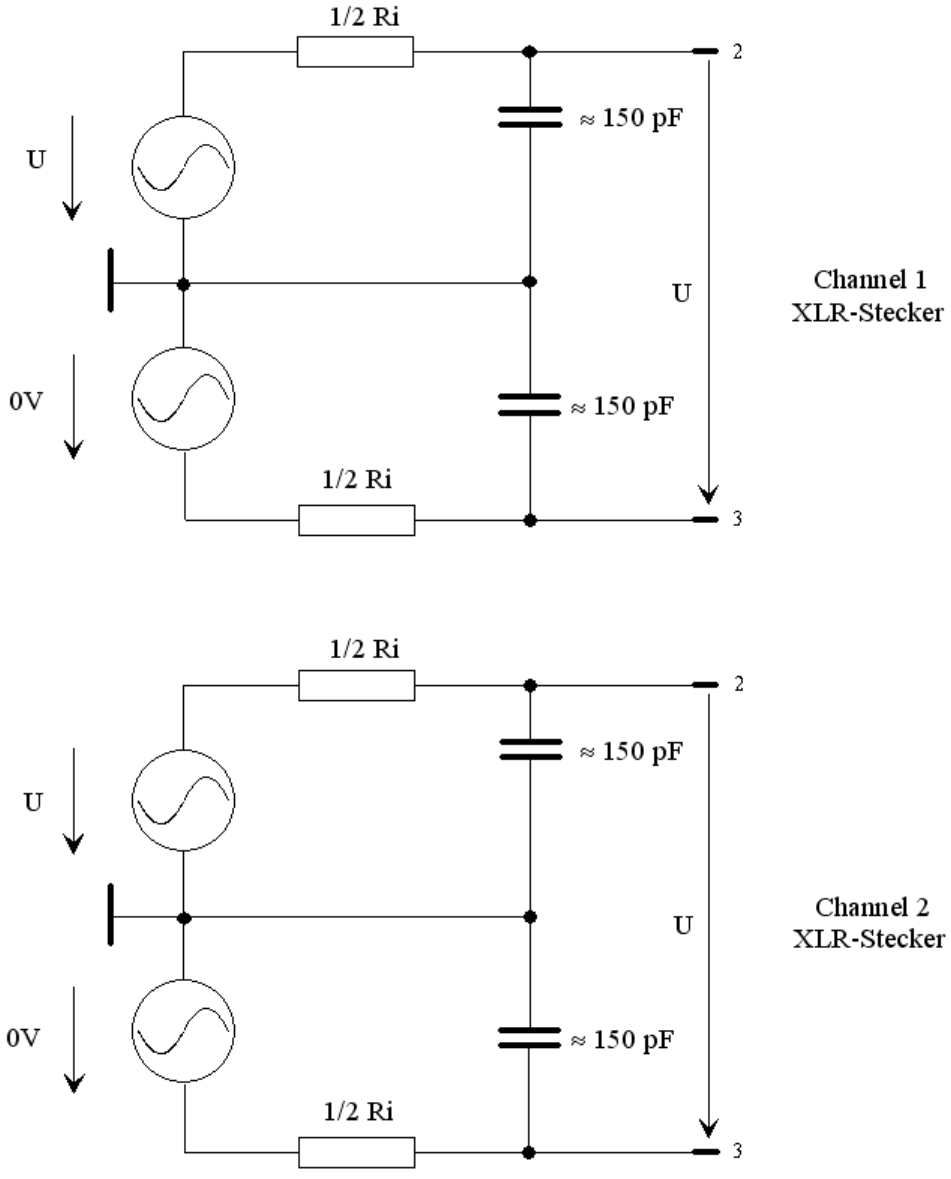


Fig. 5-2: Unbalanced Output

As can be seen in the circuit diagram, the two generator outputs are supplied by two independent sources.

The selected output impedance is retained even if the output is deactivated; XLR Pin 3 is set to 0 V, electronically floating.

Balanced Output (Output Type "Bal")

The balanced output signal is applied between Pin 2 and Pin 3 of the XLR plug. Pin 1 is not connected. The source impedance consists of two identical resistors in both signal lines.

In the schematic circuit diagrams, the ground symbol corresponds to the R&S UPP enclosure ground.

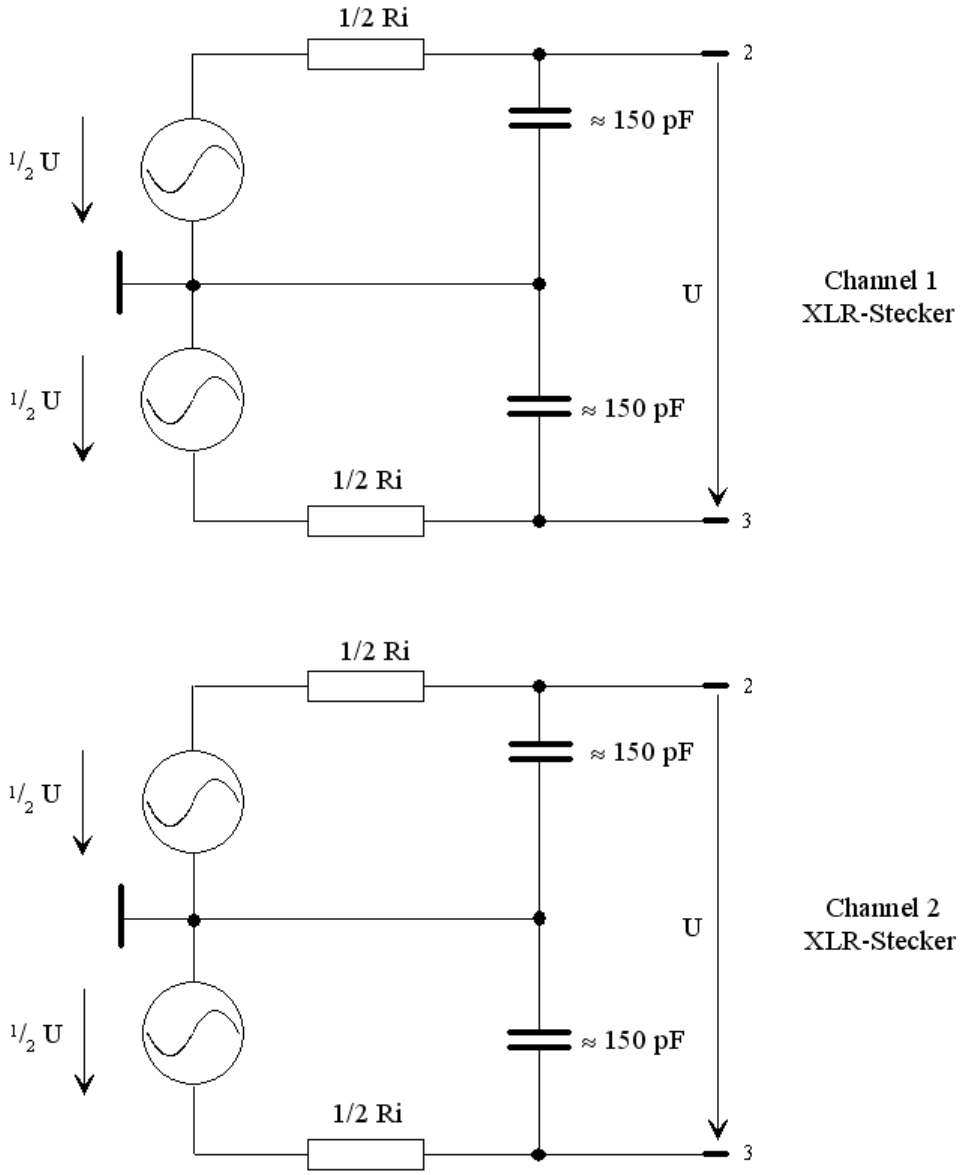


Fig. 5-3: Balanced Output

As can be seen in the circuit diagram, the two generator outputs are supplied by two independent sources.

The selected output impedance is retained even if the output is deactivated.

The above illustration applies for all generator functions.

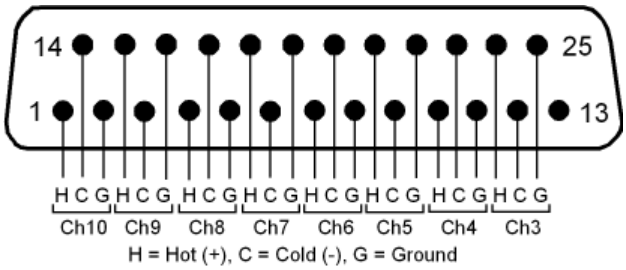
5.2.3 Output power of the universal generator

The output amplifier, attenuator and all internal resistors are short-circuit-proof. The peak value of the current is limited to about 250 mA. For a maximum average value of 14 V (symmetric mode) and 7 V (asymmetric mode), the maximum power dissipation in the load resistor (for short circuit in the internal resistor) is 2.5 W or 1.25 W.

5.2.4 Interface Assignment of the Analog Multichannel Generator

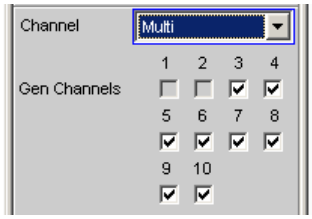
With the R&S UPP B8 option, a multichannel audio generator is available whose 8 outputs have been brought out to the pins of a 25-pin D-Sub socket.

As an accessory for the optional R&S UPP B8 (multichannel audio generator), a breakout cable with a 25-pin D-Sub connector on the one side and eight XLR connectors on the other side is available (optional R&S UP-Z8A, refer to data sheet for Order No.)



The pin assignment corresponds to the TASCAM DB-25 Pinout Standard.

The designation is the channels is Ch3 to Ch10 in agreement with the free channel selection



5.2.5 Outputs of the Analog Multichannel Generator

The outputs of the analog multichannel generator are asymmetrical and have a fixed output impedance of approx. 25 Ω. The schematic circuit diagram for the generator output is shown below.

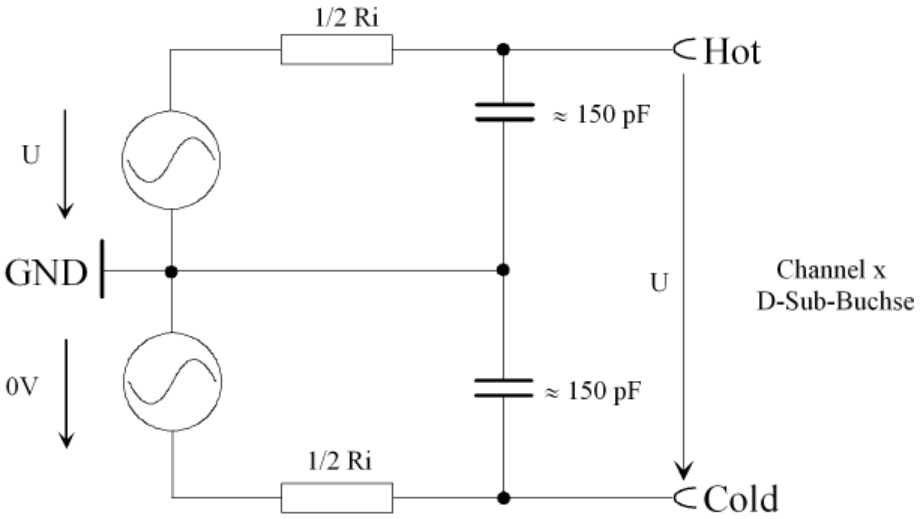


Fig. 5-4: Unbalanced Output

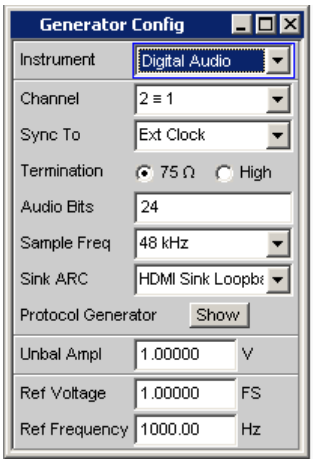
The selected output impedance is retained even if the output is deactivated. "Cold" is set to approx. 0 V, electronically floating. Accordingly, with a connected breakout cable (R&S UP-Z8A option, see data sheet for order number), Pin 3 of all 8 XLR connectors is also electronically floating.

5.2.6 Output Power of the Analog Multichannel Generator

The output amplifier, attenuator and all internal resistors are short-circuit-proof. The peak value of the current is limited to a maximum of about 30 mA. With a maximum average value of 7 V asymmetrical, the maximum power dissipation in the load resistor (with a short circuit in the internal resistor) is 150 mW per channel.

5.3 Configuring the Digital Generator

5.3.1 Digital Generator Configuration Panel

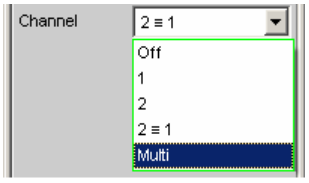


The "Digital Audio" generator instrument requires the options

- R&S UPP B2 (digital audio interfaces) for 2-channel generation or
- R&S UPP B4 (HDMI and digital audio interfaces) for 2-channel generation or
- R&S UPP B8 (multichannel audio generator) for 8-channel generation or

The configuration options of the digital audio generator are described below.

Channel
Selection of the left and right digital audio channels.



"OFF"	Both channels are deactivated. The frequency and level setting of the channels have no effect. A "blank frame" is generated that does not contain any audio data.
"1"	The left channel supplies the generator signal, the right channel is deactivated.
"2"	The right channel supplies the generator signal, the left channel is deactivated.
"2 = 1"	Both channels, left and right, return the same output signal. If the generator function "Stereo Sine" is selected, both channels may differ with regard to frequency, phase and amplitude.

"Multi" This option is offered only if the

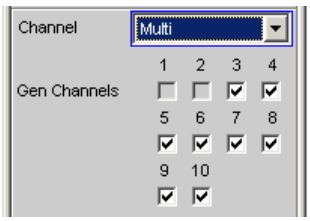
- option R&S UPP B4 (HDMI and digital audio interfaces) for the 8-channel "Digital Audio" generation is installed.
- option R&S UPP B8 (multichannel audio generator) is installed.

"Multi" enables free selection of up to 8 channels in the following parameter fields; with the "Universal" generator function, the signals can be set individually for each channel.

Remote command:
`OUTPut:CHANnel` on page 661

Gen Channels
Setting of the respectively active generator channel.

The free configuration of up to 8 channels is offered if the option R&S UPP B4 (HDMI and digital audio interfaces) has been installed for 8-channel "Digital Audio" generation or the option R&S UPP B8 (multichannel audio generator) is installed and "Multi" has been selected.

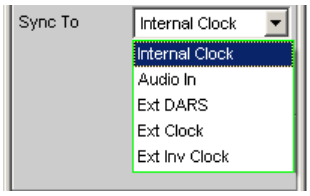


The corresponding generator channel is switched on or off.

Remote command:
`OUTPut:MCHannels<n2>` on page 664

Sync To
Used to select the source to which the digital audio generator is synchronized.

Only available with R&S UPP B2 (digital audio interfaces).



"Internal CLK" The generator is synchronized to the internal clock generator. The generator sample rate is determined by the set sample frequency.

"Audio In" Synchronizes to a digital audio signal at the "Digital In" BNC jack. The generator runs at the same sampling rate as the supplied signal.

"Ext DARS" Synchronizes to a digital audio signal.
If the R&S UPP B2 option (digital audio interfaces) is installed for the digital audio interfaces, the synchronization to a digital audio signal is done either at the asymmetrical "Sync In" BNC jack or on the 9-pin "DIGITAL BAL" D-Sub connector of the option. The selection is made in the subsequent "Sync Input" parameter field.
If the R&S UPP B4 option (HDMI and digital audio interfaces) is installed for the digital audio interfaces, the synchronization to a digital audio signal is done exclusively at the "Sync In" BNC jack of the option.
The generator runs at the same sampling rate as the supplied signal.

"Ext Clock" Synchronizes to a clock signal.
The feed of the clock signal depends on the option, see the description under "Ext DARS".
The sampling rate of the generator is determined by the frequency of the supplied clock signal.

"Ext Inv Clock" Synchronizes to an inverted clock signal.
The feed of the inverted clock signal depends on the option, see the description under "Ext DARS".
The sampling rate of the generator is determined by the frequency of the supplied clock signal.

Remote command:
`SOURce:SYNC:TO` on page 663

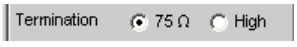
Sync Input
This parameter field appears with the installed R&S UPP B2 option (digital audio interfaces) and determines which socket is used for supplying a synchronization signal which was selected with the "Sync To" parameter field above.

"Unbal" The supply of the synchronization signal is done in asymmetric mode at the "SYNC IN" BNC jack of the option.

"Bal" The supply of the synchronization signal is done in symmetric mode at the 9-pin "DIGITAL BAL" D-Sub connector of the option at the pin contacts Pin 3 (SYNC IN-) and Pin 7 (SYNC IN+), see chapter 5.3.2, "Interface Assignment", on page 200.

Remote command:
`SOURce:SYNC:INPut` on page 662

Termination
Selection of the input termination of the synchronization signal for the modes "Ext Clock" and "Ext Inv Clock".



"75 Ω" Input termination 75 Ω

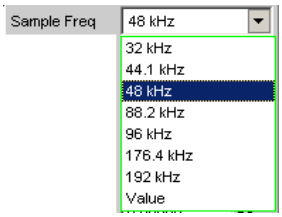
"High" High-impedance input termination

Remote command:
SOURce:SYNC:TERMination on page 663

Sample Frequency
Used to set the clock rate of the digital audio signal for the generator.

The sample frequency setting is used as a reference whenever audio data signals are generated.

The selected clock rate determines the maximum signal frequency which can be input. For sine-wave signals, it is 49.9 % of the sampling rate.



If the sample frequency entered does not match the actual clock rate (e.g. with external synchronization), all audio data signals shift accordingly in frequency.

This setting is also used to select the correct range for the Sync PLL.

Value range for numeric input:

30 kHz ... 200 kHz

Standard sampling frequencies can be set directly in the selection field.

Synchronization ranges for the generator sync PLL:

Base Rate band	30 kHz ... 64 kHz
Base Rate range	65 kHz ... 128 kHz
Base Rate band	129 kHz ... 200 kHz

"32 ...192 kHz" Standard sampling rate 32 kHz ... 192 kHz

"Value " Variable input of sampling rate

Remote command:
OUTPut:SAMPle:MODE on page 662
OUTPut:SAMPle:FREQuency on page 665

Sink ARC
With the installed R&S UPP B4 option (HDMI and digital audio interfaces), the audio return channel of the HDMI analyzer can be supplied either via direct looping of the audio signal present at the Sink socket or optionally through the SPDIF output of the digital audio generator.

"Loopback" The supplied audio signal at the Sink socket is returned via the ARC.

"Dig Aud Gen" The signal of the digital audio generator is returned via the ARC.

Remote command:
SOURce:HDMI:SARC on page 666

Protocol Generator
The R&S UPP B2 (digital audio interfaces) and R&S UPP B4 (HDMI and digital audio interfaces) options enable you to generate and analyze channel status data in the data stream of the digital audio interface according to the IEC 60958-3 standard for Consumer Mode and IEC 60958-4 or AES3 for Professional Mode.

Open the control panel for the digital audio protocol generator by means of the Show button.

Alternatively, this panel can also be opened via the "Menu bar - Instruments - Protocol Generator".

Audio Bits
If the word width is decreased, the values of the audio samples are rounded to the specified word width. Unused data bits are encoded as zeroes in the digital audio signal.

Value range: 8 ... 24

Remote command:
OUTPut:AUDiobits on page 662

Bal Ampl
Only with option R&S UPP B2 (digital audio interfaces).

Used to set the pulse amplitude of the digital audio signal at the BAL output. The configured voltage corresponds to the peak-peak value of the pulse amplitude when the output is terminated at the rated impedance (110 ohms).

The standard voltage is 4 V

Setting range: 0 V to 8,5 V

This voltage is linked to the setting for the UNBAL amplitude and is always 4 times higher than this amplitude.

Remote command:
OUTPut:SIGNal:BALanced:LEVel on page 662

Unbal Ampl
Used to set the pulse amplitude of the digital audio signal at the UNBAL (BNC) output. The configured voltage corresponds to the peak-peak value of the pulse amplitude when the output is terminated at the rated impedance (75 ohms).

The standard voltage is 1 V

Setting range: 0 V to 2,125 V

This voltage is linked to the setting for the BAL amplitude and is always a quarter of this amplitude.

Remote command:
`OUTPut:SIGNal:LEVel` on page 662

Ref Voltage
Reference value for the relative amplitude units.

If this reference value is changed, all amplitude settings linked to the reference value also change.

Remote command:
`SOURce:VOLTage:REFerence` on page 660

Ref Frequency
Reference value for the relative frequency units.

If the reference frequency is changed, all frequency settings linked to the reference value also change.

Remote command:
`SOURce:FREQuency:REFerence` on page 660

5.3.2 Interface Assignment

5.3.2.1 R&S UPP B2 digital audio interfaces

Use of the R&S UPP B2 (digital audio interfaces) option for 2-channel generation and analysis.

DIGITAL OUT

BNC output for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical output according to TOSLINK system

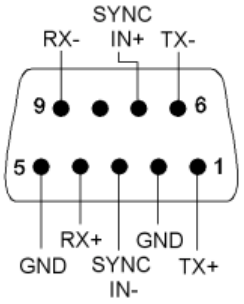
DIGITAL IN

BNC input for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical input according to TOSLINK system

SYNC IN

BNC input for synchronization signals with switchable termination.

DIGITAL BAL plug (9-pin D-Sub connector)



Connection	Signal	Input (I) Output (O)	Description
1	TX+	A	Transmitter output Bal+
2	GND		Ground terminal
3	SYNC IN-	E	Synchronization input Bal-
4	RX+	E	Receiver input Bal+
5	GND		Ground terminal
6	TX-	A	Transmitter output Bal-
7	SYNC IN+	E	Synchronization input Bal+
8			
9	RX-	E	Receiver input Bal-

5.3.2.2 R&S UPP B4 HDMI and digital audio interfaces

DIGITAL OUT

BNC output for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical output according to TOSLINK system

DIGITAL IN

BNC input for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical input according to TOSLINK system

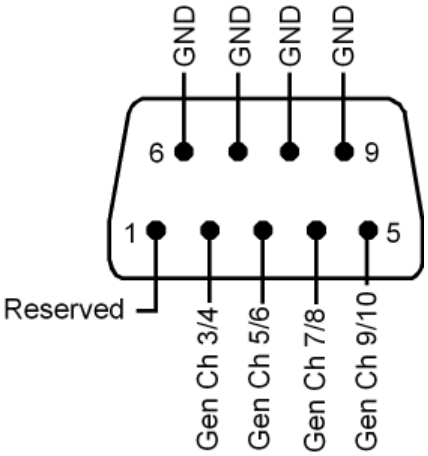
SYNC IN

BNC input for synchronization signals with switchable termination.

5.3.2.3 R&S UPP B8 multichannel audio generator

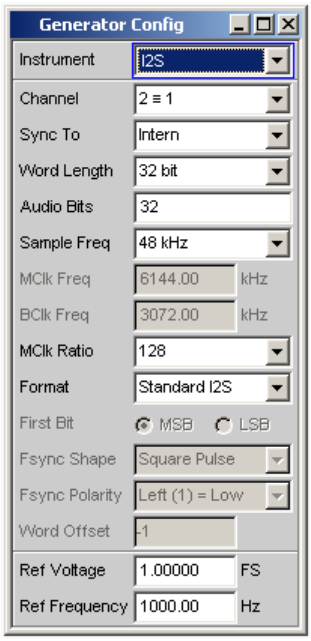
When using the R&S UPP B8 option (multichannel audio generator) for 8-channel generation, the Unbal outputs from the digital audio generator are brought out on a 9-pin D-Sub socket. The audio data is provided in S/P DIF format in accordance with IEC 60958.

As an accessory for the optional R&S UPP B8 (multichannel audio generator), a break-out cable with a 9-pin D-Sub connector on the one side and five BNC connectors on the other side is available (optional R&S UP-Z8D, refer to data sheet for Order No.)



5.4 Configuring the I²S Generator

5.4.1 I²S Generator Configuration Panel

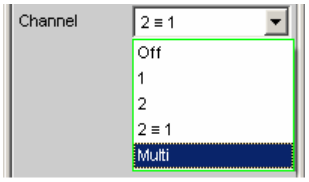


The "I²S" generator instrument requires the R&S UPP B2 option (digital audio interface) or the R&S UPP B4 option (HDMI and digital audio interfaces) for 2-channel and 8-channel "I²S" generation respectively.

A difference in the Config panel due to the installation of the R&S UPP B2 (digital audio interfaces) or R&S UPP B4 (HDMI and digital audio interfaces) options applies only to the "Channel" command with the "Multi" option, which is offered only for 8-channel "I²S" generation.

The configuration options of the "I²S" generator are described below.

Channel
Setting of the respectively active generator channel.



"OFF" Both channels are deactivated.
The frequency and level setting of the channels have no effect.
A "blank frame" that does not contain any audio data (all bits = null) is generated.

"1" Only the left channel supplies the generator signal; the right channel is deactivated (all bits = null).

"2" Only the right channel supplies the generator signal; the left channel is deactivated (all bits = null).

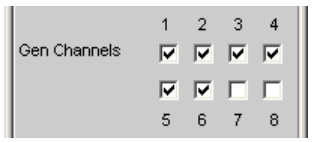
"2 = 1" Both channels, left and right, return the same output signal.

"Multi" This selection item is offered only if the R&S UPP B4 (HDMI and digital audio interface) option for 8-channel "I²S" generation is installed and enables the free configuration of up to 8 channels in the following parameter fields.

Remote command:
`OUTPut:CHANnel` on page 661

Gen Channels
Setting of the respectively active generator channel.

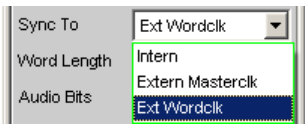
The free configuration of up to 8 channels is provided if the R&S UPP B4 (HDMI and digital audio interfaces) option for 8-channel "I²S" generation is installed and if the "Multi" parameter field above has been selected.



The corresponding generator channel is switched on or off.

Remote command:
`OUTPut:MCHannels<n2>` on page 664

Sync To
Used to select the source to which the I²S generator is synchronized.



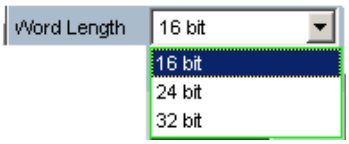
"Intern" The generator uses the instrument's internal clock signal.
The sampling rate of the generator is based on the configured value.

"Ext Mclk" Synchronization to the external master clock fed in at the SYNC IN BNC jack on the front of the R&S UPP B2 (digital audio interfaces) or B4 (HDMI and digital audio interfaces) option. The sampling rate of the generator is determined using the parameter MClk Ratio. Sample Freq= f MCLK/MClk Ratio.

"Ext Wordclk" Synchronizes to the external word clock supplied at the BNC jack SYNC IN of the R&S UPP B2/B4 option. The sampling rate of the generator corresponds directly to the frequency of the supplied clock signal.

Remote command:
`SOURce:SYNC:TO` on page 663

Word Length
Word width of one data frame per channel in bits.

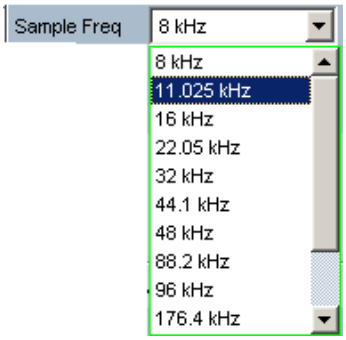


Remote command:
`OUTPut:WLENgth` on page 665

Sample Freq
Setting the sampling frequency.

The sampling frequency corresponds to the frequency of the FSYNC signal. All frequency information of generated audio data relates to this setting. If the I²S generator is operated with external wordclock synchronization and the frequency of the external clock signal does not correspond to the set sampling frequency, the I²S generator generates audio data with an incorrect frequency. Even with external masterclock synchronization, the external clock signal must correspond to the set sampling frequency multiplied by the selected MClk ratio. Otherwise, the I²S generator also generates audio data with an incorrect frequency.

The selected clock rate determines the maximum signal frequency which can be input. For sine-wave signals, this is 49.9 % of the sampling rate.



The standard sampling frequencies can be set directly in the selection field.

The selection item "Value" permits the variable input of the sampling rate in the following line.

Value range for numeric input:

6.75 kHz to 200 kHz

Remote command:

`OUTPut:SAMPle:MODE` on page 662

`OUTPut:SAMPle:FREQuency` on page 665

MClk Freq

Display of the master clock frequency based on the relationship: "Sample Freq" * "MClk Ratio".

Value range: 864 kHz to 49.152 MHz

Remote command:

`OUTPut:FSYNc:FREQuency?` on page 664

BClk Freq

Display of the bit clock frequency. This is calculated from the product of Word Length / Sample Freq.

Value range: 216 kHz to 12.80 MHz

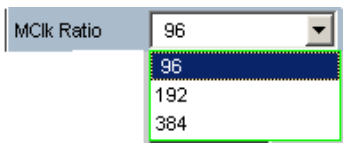
Remote command:

`OUTPut:BCLK:FREQuency?` on page 663

MClk Ratio

Ratio between MCLK and FSYNC.

Value range: 64, 96, 128, 192, 256, 384, 512



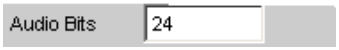
The value range of the MClk ratio (and thus the selection available in the combo box) varies based on "Word Length" and "Sample Freq".

Remote command:
`OUTPut:MCLKratio` on page 665

Audio Bits
Word width of the audio data within a frame.

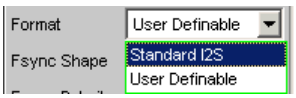
Audio samples are rounded to the specified word length. Unused data bits are coded as zeros.

Value range: 8 to Word Length



Remote command:
`OUTPut:AUDiobits` on page 662

Format
Selection of the I²S generator function.



"Standard I²S" The I²S generator transmits in the standard I²S format.
The following parameters that have an effect on the format have **fixed default settings**:
Fsync Shape = Square Pulse
Fsync Polarity = Left(1) = Low
Word Offset = -1

"User Def." The I²S generator transmits in a format similar to I²S.
The following parameters are additionally available:
Fsync Shape
Fsync Polarity
Word Offset

Remote command:
`OUTPut:FORMat` on page 664

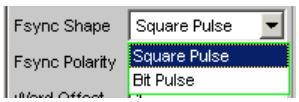
First Bit
Defines the sequence in which the data bits are transmitted

"MSB" The most significant bit is transmitted first.

"LSB" The least significant bit is transmitted first.

Remote command:
`OUTPut:FBIT` on page 664

Fsync Shape
Selection of the FSYNC signal form.



"Square Pulse" The FSYNC signal is transmitted as a symmetrical rectangle.

"Bit Pulse" The FSYNC signal is transmitted as a bit pulse.

Remote command:
`OUTPut:FSHape` on page 664

Fsync Polarity
Polarity of the FSYNC signal

The selection varies, and is available depending on the setting of Fsync Shape = Square Pulse or Bit Pulse.

"Left (1) = Low" Fsync Shape = Square Pulse
While the left channel (channel 1) is being sent, a low level is applied at the FSYNC signal at a word offset of 0.

"Left (1) = High" Fsync Shape = Square Pulse
While the left channel (channel 1) is being sent, a high level is applied at the FSYNC signal at a word offset of 0.

"Positive" Fsync Shape = Bit Pulse
At a Word Offset of 0, a positive pulse marks the beginning of the left data word.

"Negative" Fsync Shape = Bit Pulse
At a Word Offset of 0, a negative pulse marks the beginning of the left data word.

Remote command:
`OUTPut:POLarity` on page 665

Word Offset
By using Word Offset, you can set the number of SCK clock cycles by which the Fsync signal transmission is delayed relative to the audio data.

Value range: -Word Length to 0 to +Word Length-1

Remote command:
`OUTPut:WOFFset` on page 665

Ref Voltage
Reference value for the relative amplitude units.

If this reference value is changed, all amplitude settings linked to the reference value also change.

Remote command:
`SOURce:VOLTage:REFerence` on page 660

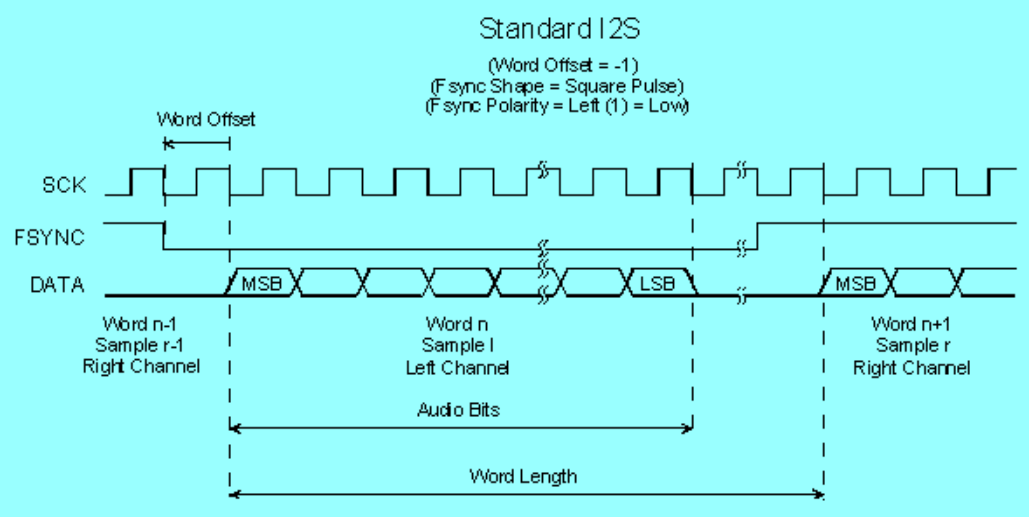
Ref Frequency
Reference value for the relative frequency units.

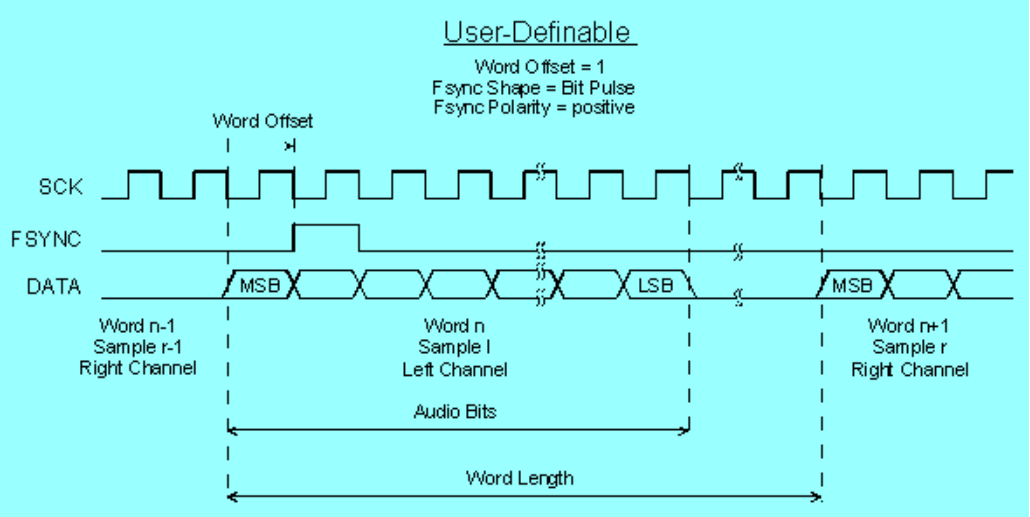
If case of a change, all frequency settings linked to the reference frequency also change.

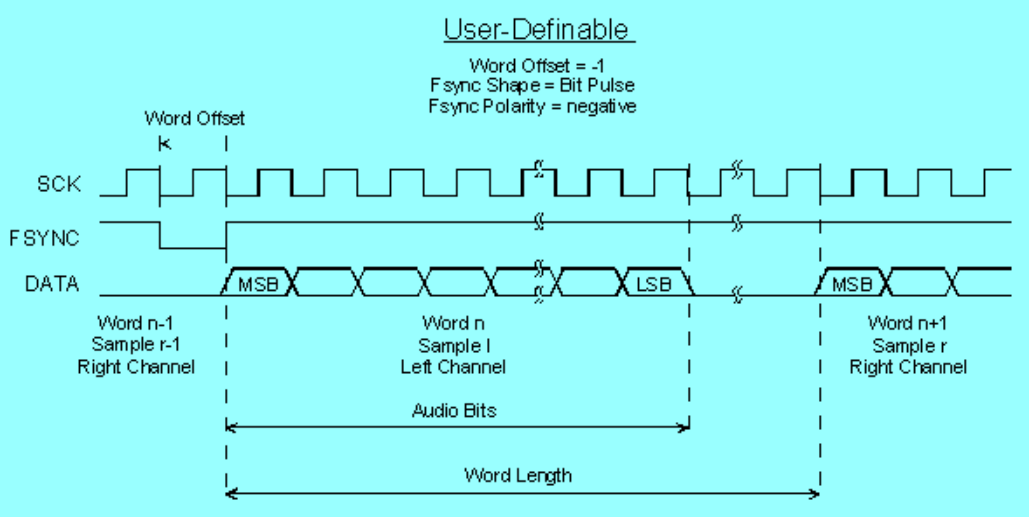
Remote command:
SOURce:FREQuency:REFerence on page 660

5.4.2 Timing Diagrams

The timing diagrams below show a number of configuration examples that illustrate the effect of the parameters.

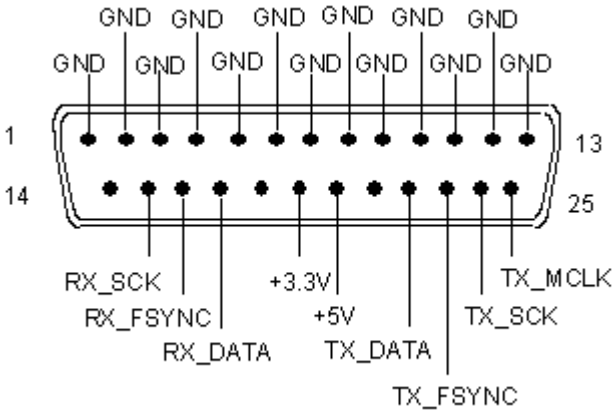






5.4.3 Interface Assignment

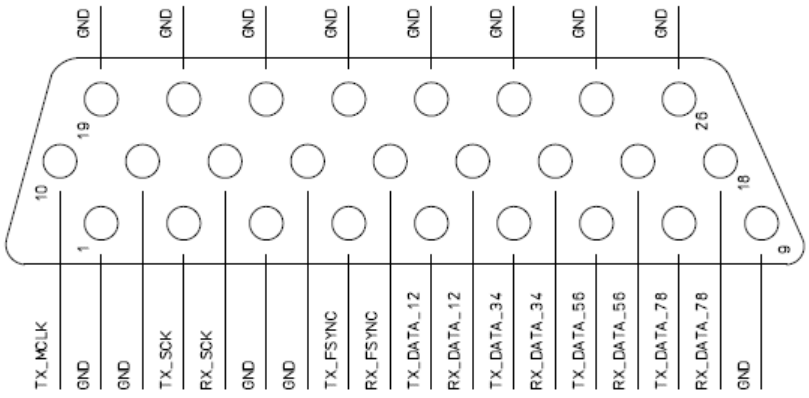
I²S plug (25-pin D-Sub connector) of the R&S UPP B2 (digital audio interfaces) option.



Connection	Signal	Input (I) Output (O)	Description
1	GND		Ground terminal
2	GND		Ground terminal
3	GND		Ground terminal
4	GND		Ground terminal
5	GND		Ground terminal
6	GND		Ground terminal
7	GND		Ground terminal
8	GND		Ground terminal

Connection	Signal	Input (I) Output (O)	Description
9	GND		Ground terminal
10	GND		Ground terminal
11	GND		Ground terminal
12	GND		Ground terminal
13	GND		Ground terminal
14	not connected		
15	RX_SCK	E	Serial Clock Analyzer
16	RX_FSYNC	E	Frame Sync Analyzer
17	RX_DATA	E	Serial Data Analyzer
18	not connected		
19	+3.3 V (500 mA)	A	Power Supply
20	+5 V (500 mA)	A	Power Supply
21	not connected		
22	TX_DATA	A	Serial Data Generator
23	TX_FSYNC	A	Frame Sync Generator
24	TX_SCK	A	Serial Clock Generator
25	TX_MCLK	A	Master Clock Output Generator

I²S plug (26-pin D-SUB-HD connector) of the R&S UPP B4 (HDMI and digital audio interfaces) option.



Connection	Signal	Input (I) Output (O)	Description
1	GND		Ground terminal
2	TX SCK	A	Serial Clock Generator

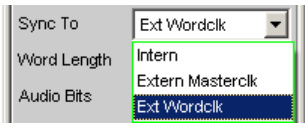
Connection	Signal	Input (I) Output (O)	Description
3	GND		Ground terminal
4	TX FSYNC	A	Frame Sync Generator
5	TX DATA Ch 1,2	A	Serial Data Generator Ch1,2
6	TX DATA Ch 3,4	A	Serial Data Generator Ch3,4
7	TX DATA Ch 5,6	A	Serial Data Generator Ch5,6
8	TX DATA Ch 7,8	A	Serial Data Generator Ch7,8
9	GND		Ground terminal
10	TX MCLK	A	Master Clock Output Generator
11	GND		Ground terminal
12	RX_SCK	E	Serial Clock Analyzer
13	GND		Ground terminal
14	RX FSYNC	E	Frame Sync Analyzer
15	RX DATA Ch 1,2	E	Serial Data Analyzer Ch 1,2
16	RX DATA Ch 3,4	E	Serial Data Analyzer Ch 3,4
17	RX DATA Ch 5,6	E	Serial Data Analyzer Ch 5,6
18	RX DATA Ch 7,8	E	Serial Data Analyzer Ch 7,8
19	GND		Ground terminal
20	GND		Ground terminal
21	GND		Ground terminal
22	GND		Ground terminal
23	GND		Ground terminal
24	GND		Ground terminal
25	GND		Ground terminal
26	GND		Ground terminal

SYNC IN (BNC jack)

Connection	Signal	Input (I) Output (O)	Meaning
Outer conductor	GND		Ground terminal
Inner conductor	TX_CLK	E	Sync Input Generator

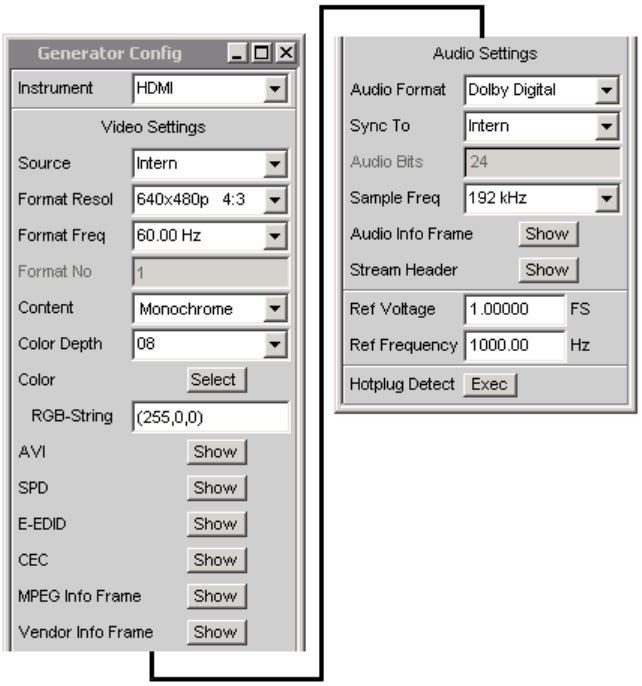
An external master clock or word clock is fed in at the SYNC IN BNC jack of the R&S UPP B2 (digital audio interfaces) or R&S UPP B4 (HDMI and digital audio inter-

face) option. The desired clock is selected in the parameter field "Sync To " with "Extern Masterclk " or "Ext Wordclk ".



5.5 Configure HDMI Generator

5.5.1 HDMI Generator Configuration Panel



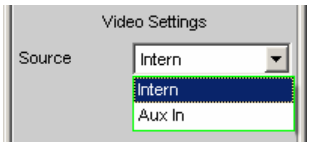
The "HDMI" generator instrument requires the R&S UPP B4 (HDMI and digital audio interfaces) options.

SCPI command:

SOURce:FUNCtion on page 668

The Config panel enables the settings of the digital HDMI generator which is described below.

Source
Selection of the video source. In the HDMI generator, the video data and test patterns can be generated either internally or supplied via the AUX IN socket, combined with the audio signals and output at the SOURCE socket. In this mode, all info frames are also copied to the SOURCE socket, with the exception of the internally generated audio info frames.

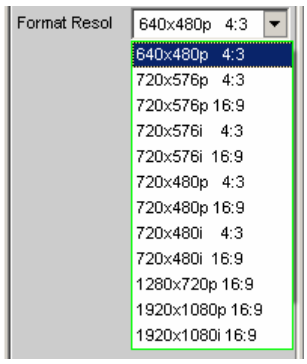


"Intern" The video data are internally generated. The test signal is selected via the "Pattern" parameter field.
The "Internal" selection in conjunction with "Pattern" = "Lip Sync" automatically provides the "Lip Sync" generator function. The trigger pattern used for this measuring function must be generated internally.

"Aux In" The AUX IN socket can be used to supply externally generated video data, combined with the internally generated audio signals and output via the SOURCE socket.

Remote command:
`SOURce:HDMI:VIDeo:SOURce` on page 667

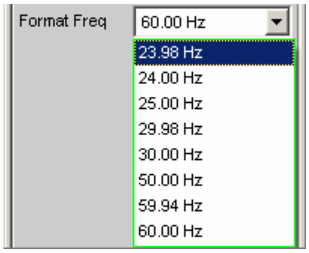
Format Resol
This selection describes the horizontal and vertical resolution as well as the aspect ratio of the created video format according to the CEA-861 standard.



Depending on the selected resolution, one or several VSYNC frequencies can be selected in the following parameter field The resulting video identification code according to CEA-861 is shown in the "Format No" field.

Remote command:
`SOURce:HDMI:VIDeo:RESolution` on page 667

Format Freq
Selection of the vertical video frequency. Corresponds to the VSYNC frequency. The values available for selection are oriented to the previously selected resolution according to CEA-861.



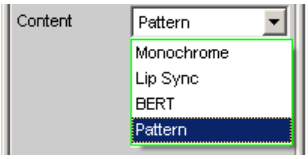
Depending on the selected resolution in the parameter field above, one or several vertical frequencies can be selected. The resulting video identification code according to CEA-861 is shown in the "Format No" field.

Remote command:
`SOURce:HDMI:VIDeo:FREQuency` on page 667

Format No
Video identification code of the generated video signal according to CEA-861. The ID code is copied to the AVI Info Frame of the HDMI generator signal during the format selection.

Remote command:
`SOURce:HDMI:VIDeo:FORMat?` on page 666

Content
Generated test pattern.



"Monochrome" A monochrome picture content with selectable color depth is being generated.

"Lip Sync" Available only with the R&S UPP K45 (expanded audio/video measurements) option.
The "Lip Sync" selection in conjunction with "Source" = "Internal" restricts the availability of the generator functions to the "Lip Sync" function and adjusts it. A selectable trigger pattern with defined time reference to the audio data is generated to detect picture and sound latency.

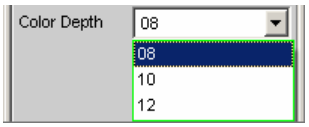
"BERT" Available only with the R&S UPP K45 (expanded audio/video measurements) option.
Generation of bit patterns for measuring the bit error rate of the video data of an HDMI transmission path. The analyzer measuring function "BERT" requires the settings "Source" = "Intern" and "Pattern" = "BERT" in the generator, otherwise a corresponding message appears.

"Pattern" Available only with the R&S UPP K45 (expanded audio/video measurements) option.
Generation of test patterns.

Remote command:
SOURce:HDMI:VIDeo:CONTent on page 666

Pattern Config
Editor for generating test patterns.

Color Depth
Selection of color depth of the picture data in bit.



Remote command:
SOURce:HDMI:VIDeo:COLor:DEPTh on page 666

Color
If "Pattern" = "Monochrome" was selected, the color of the picture to be output can be configured with the color selection dialog. In the following parameter field, the colors are always shown as decimal equivalents of 12-bit long numeric values. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

RGB string

If "Pattern" = "Monochrome" was selected, the color selection from the color selection dialog above is mapped as RGB string and can be configured here, if necessary. In each case, the decimal equivalent of 12-bit long numeric values is mapped. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

AVI
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a dialog in which the currently set AVI Info Frame of the generator is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

SPD
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a dialog in which the currently set SPD Info Frame of the generator is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

E-EDID
Opens a dialog displaying the data structure of one of the HDMI loads connected to the SOURCE socket. This information CANNOT be modified since it represents information transmitted by the DUT. The structure of the E-EDID data is specified in the VESA Enhanced Extended Display Identification Data standard.

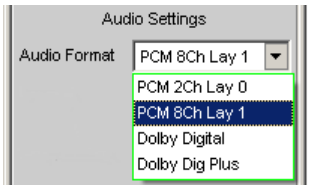
MPEG Info Frame
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a dialog in which the currently set MPEG info frame of the generator is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

Vendor Info Frame
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a dialog in which the currently set vendor-specific info frame of the generator is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

Audio Format
Selection of the audio format generated in the HDMI generator.



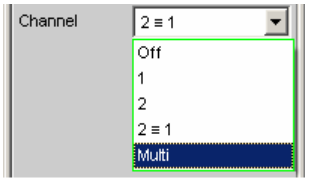
The **Dolby** formats are available only with the R&S UPP K41 (Dolby decoding) option.

Note: For encoded audio formats, all of the parameter fields that could cause level manipulation to the data stream are hidden in the "Play" generator function because level manipulation to encoded formats would destroy the content.

"PCM 2ChLay 0"	PCM stereo signal. The "Channel" parameter field underneath it allows configuring two channels.
"PCM 8Ch Lay 1"	8-channel PCM data. In addition to the 2-channel settings, the "Channel" parameter field underneath it also offers the "Multi" option which enables the open configuration of up to 8 channels.
"Dolby Digital"	Playing a Dolby Digital audio file. The available generator functions are limited to the "Play" selection.
"Dolby Dig Plus"	Playing a Dolby Digital Plus audio file. The available generator functions are limited to the "Play" selection.

Remote command:
`SOURce:HDMI:AUDio:FORMat` on page 666

Channel
Selection of the active generator channels for internally generated PCM formats. The channel selection is not offered for the generation of encoded audio formats.



"OFF" All channels are switched off.
The frequency and level setting of the channels have no effect.
Zero samples are being generated.

"1" Only the left channel supplies the generator signal; the right channel is deactivated (all bits = null).

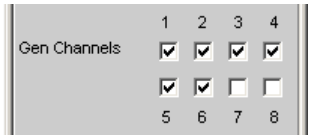
"2" Only the right channel supplies the generator signal; the left channel is deactivated (all bits = null).

"2 = 1" Left and right channel furnish the same output signal.

"Multi" The option can be selected only if "PCM 8Ch Lay 1" is selected in the parameter field above and it allows the open configuration of up to 8 channels in the following parameter fields.

Remote command:
`OUTPut:CHANnel` on page 661

Gen Channels
Setting of the respective active generator channel for the audio format "PCM 8Ch Lay1" with the "Multi" channel setting.



Remote command:
`OUTPut:MCHannels<n2>` on page 664

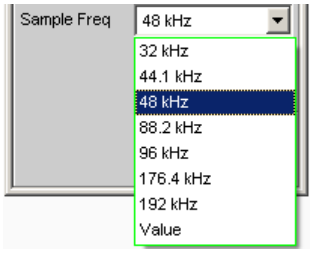
Sync To
Determines the source of the master clock used for the audio signal generation.

"Intern" All audio clocks are generated internally. The selection of the sampling rate is not affected by external signals.

"Aux In" The audio master clock is determined by the audio signal supplied at the AUX IN socket, regardless of whether the sampling rate is supported by the video format selected in the HDMI generator or not.

Remote command:
`SOURce:SYNC:TO` on page 663

Sample Freq
Selecting of the sampling rate of the generated audio data.



"Fixed frequencies" The permissible scanning rates depend on the selected "audio format" and the video "Format Resol". For the audio format "PCM 8Ch Lay1", the selected video "Format Resol" determines the permissible sample frequencies - only they will be offered. For all other audio formats, sample frequencies in the range from 30.72 kHz to 192 kHz are available. The corresponding dependencies between video format and supported sampling rates can be found in the HDMI 1.4 specification under item 7.3.3 "Video Dependency".

"Value " Allows entering a "freely" selectable frequency within certain limits. At this point, values that deviate by no more than 4% from a standard sampling rate allowed for this video format are permissible.

Remote command:
`OUTPut:SAMPle:MODE` on page 662

Sample Freq Value
Variable entry of a sampling frequency in Hz or kHz, if "Value" was selected in the input field above.

Entry values from -4% to +4% of the allowed standard sampling frequencies are permissible and are copied without changes. Entry values outside of this range are automatically corrected to -4% or +4% of the next closest standard sampling frequency.

Remote command:
`OUTPut:SAMPle:FREQuency` on page 665

Audio Info Frame
Opens a dialog in which the content of the current Audio Info Frame of the generator is shown. The data structure of this Info Frame is specified in the CEA-861 standard document.

Stream Header
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a dialog in which audio-relevant information of the HDMI stream header can be displayed and changed. This data structure consists of the channel status bytes 0 to 4 of a consumer format according to IEC 60958.

Ref Voltage
Reference value for the relative amplitude units.

If this reference value is changed, all amplitude settings linked to the reference value also change.

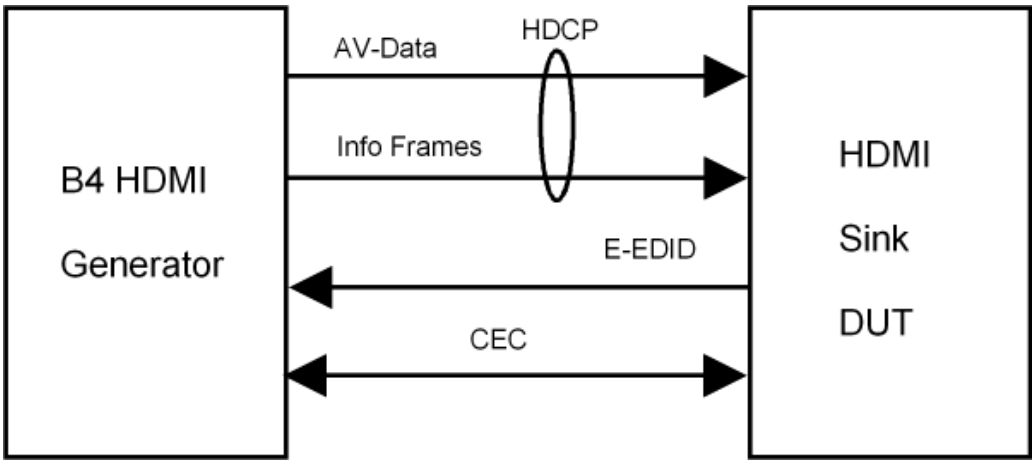
Remote command:
`SOURce:VOLTage:REFerence` on page 660

Ref Frequency
Reference value for the relative frequency units.

If the reference frequency is changed, all frequency settings linked to the reference value also change.

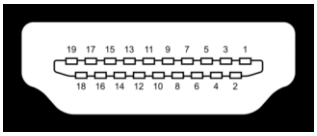
Remote command:
`SOURce:FREQuency:REFerence` on page 660

5.5.2 Signal Flow between R&S UPP and DUT



5.5.3 Interface Assignment of HDMI

All HDMI sockets follow the standard assignment for HDMI 1.4.

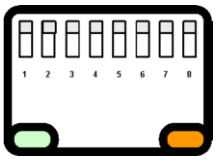


Pin	Signal	Pin	Signal
1	TMDS Data2+	11	TMDS Clock Shield
2	TMDS Data2 Shield	12	TMDS Clock–
3	TMDS Data2–	13	CEC

Pin	Signal	Pin	Signal
4	TMDS Data1+	14	Reserved (HDMI 1.0-1.3c), HEC Data- (Optional, HDMI 1.4+ with Ethernet)
5	TMDS Data1 Shield	15	SCL (I²C Serial Clock for DDC)
6	TMDS Data1–	16	SDA (I²C Serial Data Line for DDC)
7	TMDS Data0+	17	DDC/CEC/HEC Ground
8	TMDS Data0 Shield	18	+5 V Power (max 50 mA)
9	TMDS Data0–	19	Hot Plug Detect (all versions), HEC Data+ (Optional, HDMI 1.4+ with Ethernet)
10	TMDS Clock+		

5.5.4 Interface Assignment of HEC

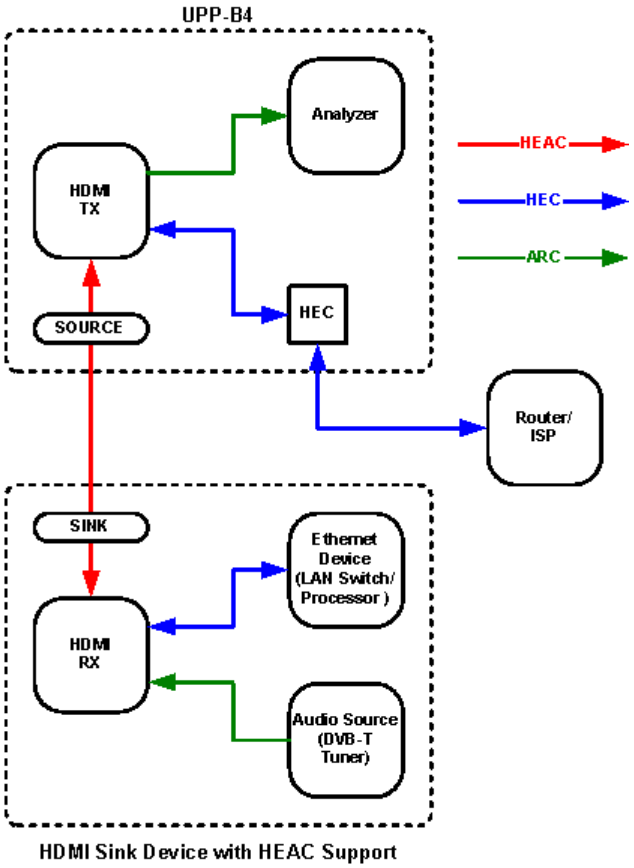
All Ethernet sockets follow the RJ-45 standard assignment.



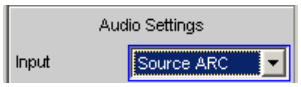
Pin	Signal
1	TX+
2	TX-
3	RX+
4	NC
5	NC
6	RX-
7	NC
8	NC

5.5.5 HEAC Support

The HDMI generator supports the Audio Return Channel (ARC) as well as the HDMI Ethernet Channel (HEC). The following block diagram illustrates the internal wiring:



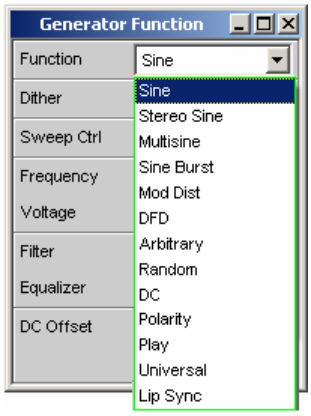
For the analysis of the Audio Return Channel fed into the generator socket at the rear side, the "Input" audio can be set to "Source ARC" in the Analyzer Config Panel.



To test the Ethernet functionality of a device under test, the HEC (Source) RJ-45 socket can be used.

5.6 Generator Signals

The section "Generator Signals" describes the setting parameters for all signals which can be generated at the analog or digital outputs. The signals are selected using the "Function" selection field in the "Generator Function" panel. The selected function determines which parameter fields are available in the panel.



The panels for the analog and digital generator are almost identical; the settings are therefore described together. Any differences are indicated.

If the R&S UPP B8 (multichannel audio generator) option is installed and the multi-channel generator was activated in the generator instrument "Analog" or "Digital Audio" with "Channel" = "Multi", individual signals can be configured for all selected channels using the "Universal" generator function (see chapter 5.6.12, "Universal", on page 254). All other generator functions cause perfectly identical signals on all selected channels.

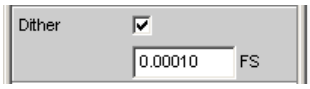
5.6.1 Sine

The generator generates a sine-wave signal. Frequency and level are the same for both channels.

SCPI command:

SOURce:FUNCtion on page 668

Dither



In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The checkbox enables or disables this function.

The parameter fields for Dither do not appear in the analog generator.

Remote command:

SOURce:SINusoid:DITHer:STATe on page 669
SOURce:SINusoid:DITHer on page 669

Sweep Ctrl

Used to enable the sweep system. The frequency or level of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between Start and Stop or read out of the file.

Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

Frequency
Used to set the frequency of the sine wave. The value range depends on the analog bandwidth set in the Generator Config panel or the digital clock rate. Sinusoidal signals from digital generators can be generated up to 49.9 % of the sampling rate.

Note: If Gen Track is selected as the measuring time in the analyzer, the measuring time and generator frequency are synchronized such that the signal periods recorded during the measuring time contain an entire number of samples. If necessary the generator frequency is modified slightly to allow this to happen.

Remote command:
`SOURce:FREQuency<n2>` on page 668

Voltage
Used to set the level of the sine wave. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

Remote command:
`SOURce:VOLTage<n2>` on page 669

Signal change at zero crossing
This function can be selected in all generator instruments, but is available in the analog generator only with the "Volt Range" = "Fix" setting.

When there is a change in frequency or level, the signal change occurs **seamlessly** at the next zero crossing.

Remote command:
`SOURce:SIGChange` on page 669

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
`SOURce:FILTer` on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field, see chapter 5.7, "Equalization", on page 265.

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:

`SOURce:VOLTage:OFFSet<n3>:STATe` on page 670

`SOURce:VOLTage:OFFSet<n3>` on page 670

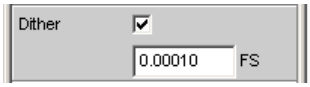
5.6.2 Stereo Sine

The generator generates a sine-wave signal on both channels. The frequency, level and phase can be set freely and separately for Channel 1 and 2.

SCPI command:

`SOURce:FUNCtion` on page 668

Dither



In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The checkbox enables or disables this function. The Dither setting is the same for both channels.

The parameter fields for Dither do not appear in the analog generator.

Remote command:

`SOURce:SINusoid:DITHer:STATe` on page 669

`SOURce:SINusoid:DITHer` on page 669

Freq Mode

Determines the frequency and phase setting for Channel 1 and 2. The value range for frequency depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

"f&Ph" Channel 1 and 2 have the same frequency but the phase between the two channels can be selected.
With the frequency sweep, the phase between the two channels remains constant.

"Ch1&2" The frequency can be entered separately for Channel 1 and 2. There is no fixed phase relationship between the channels.
With the frequency sweep, the frequency of Channel 1 is swept but Channel 2 remains unchanged.

Note: If Gen Track is selected as the measuring time in the analyzer, measuring channel 1 follows the frequency of generator channel 1 and measuring channel 2 follows the frequency of generator channel 2.

Remote command:
`SOURce:FREQuency:SELect` on page 672

Volt Mode
Determines the level setting for Channel 1 and 2. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

"Ch2/1" The levels of Channel 1 and 2 have a fixed ratio relative to each other.
With the level sweep, this ratio remains constant.

"Ch1&2" The level can be set separately for Channel 1 and 2.
With the level sweep, the level of Channel 1 is swept but Channel 2 remains unchanged.

Remote command:
`SOURce:VOLTage:SELect` on page 673

Sweep Ctrl
Used to enable the sweep system. The frequency, phase or level of the signal can be varied within a selectable range from the start to the stop value. The Freq Mode and Volt Mode settings determine how frequencies and levels are changed during the sweep.

If frequency, phase or level is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between Start and Stop or read out of the file.

Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

Frequency
The frequency is identical for both channels (Freq Mode F&Ph).

Note: If Gen Track is selected as the measuring time in the analyzer, the measuring time and generator frequency are synchronized such that the signal periods recorded during the measuring time contain an entire number of samples. If necessary the generator frequency is modified slightly to allow this to happen.

Remote command:
`SOURce:FREQuency<n2>` on page 668

Freq Ch1
Frequency of Channel 1 (Freq Mode Ch1&2).

Note: If Gen Track is selected as the measuring time in the analyzer, measuring channel 1 follows the frequency of generator channel 1. The generator frequency may be modified slightly so that the signal periods measured during the measuring time contain an entire number of samples.

Remote command:
SOURce:FREQuency<n2> on page 668

Volt Ch1
Level of Channel 1.

Remote command:
SOURce:VOLTage<n2> on page 669

Phase Ch2/1
Phase of Channel 2 relative to Channel 1 (Freq Mode F&Ph).

Remote command:
SOURce:PHASe<n2> on page 672

Freq Ch2
Frequency of Channel 2 (Freq Mode Ch1&2).

Note: If Gen Track is selected as the measuring time in the analyzer, measuring channel 2 follows the frequency of generator channel 2. The generator frequency may be modified slightly so that the signal periods measured during the measuring time contain an entire number of samples.

Remote command:
SOURce:FREQuency:CH2Stereo on page 671

Volt Ch2
Level of Channel 2 (Volt Mode Ch1&2).

Remote command:
SOURce:VOLTage:CH2Stereo on page 672

Volt Ch2/1
Ratio of the level of both channels relative to Channel 1 (Volt Mode Ch2/1).

Remote command:
SOURce:VOLTage:RATio on page 672

Signal change at zero crossing
This function can be selected in all generator instruments, but is available in the analog generator only with the "Volt Range" = "Fix" setting. "Freq Mode" has to be set to "Ch1&2".

When there is a change in frequency or level, the signal change occurs **seamlessly** at the next zero crossing.

Remote command:
SOURce:SIGChange on page 669

Filter

The filter can be selected for both channels together (Track) or separately from each other (Split).

Remote command:
SOURce:FILTer:CHANnels on page 671

Filter / Filter Ch1

Common filter for channel 1 and channel 2, if "Track" filter was selected. Filter for channel 1, if "Split" filter was selected.

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Filter Ch2

Filter for channel 2, if "Split" filter was selected.

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:STEReo<n2>:FILTer on page 740

Equalizer

The equalizer can be selected for both channels together (Track) or separately from each other (Split).

Remote command:
SOURce:VOLTage:EQUalize:CHANnels on page 672

Equalizer / Equalizer Ch1

Common equalizer for channel 1 and channel 2, if "Track" equalizer was selected. Equalizer for channel 1, if "Split" equalizer was selected.

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File/Equal File Ch1" parameter field. The checkbox enables or disables this function. The precorrection is the same for both channels.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

Remote command:
SOURce:VOLTage:EQUalize on page 670
MMEMory:LOAD:OEQualize on page 668

Equalizer Ch2
Equalizer for channel 2, if "Split" equalizer was selected.

The generator signal is precorrected in the frequency domain using the file selected in the ""Equal File CH2"" parameter field. The checkbox enables or disables this function. The precorrection is the same for both channels.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

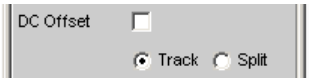
Remote command:
MMEMory:LOAD:STEReo<n3>:OEQualize on page 671
SOURce:VOLTage:STEReo<n3>:EQUalize on page 673

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670

DC Offset



The DC Offset can be selected for both channels together (Track) or separately (Split).

Remote command:
SOURce:VOLTage:OFFSet:CHANnels on page 672

Offset Ch1
Common DC Offset for channel 1 and channel 2, if "Track" DC Offset was selected.
DC Offset for channel 1, if "Split" DC Offset was selected.

Remote command:
SOURce:VOLTage:OFFSet<n3> on page 670

Offset Ch2
DC Offset for channel 2, if "Split" DC Offset was selected.

Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670

5.6.3 Multi-sine

The generator generates a multi-tone signal with up to 32 sine-wave tones. The frequency, level and phase can be freely selected for each tone. However, it is also possible to optimize the phase so that the ratio of peak value to rms value is minimal, as is often required in the case of noise-like signals. Owing to the absence of associated windowing, linking the frequency spacing of the multi-sine wave to the resolution of the FFT allows extremely fast frequency response measurement.

SCPI command:

`SOURce:FUNCtion` on page 668

Spacing

Used to set the frequency spacing. The frequency of each sine-wave line is an integer multiple of this frequency spacing.

"Def" The frequency spacing can be freely defined.
Minimum value: Sampling rate/262144

"Anl Trk" The frequency spacing is adopted from the FFT set in the analyzer. This value depends on the sampling rate and the size of the FFT. This setting is only possible if an FFT or Post FFT is selected in the analyzer.
The parameter field for entering values is then hidden.

Remote command:
`SOURce:RANDom:SPACing:MODE` on page 674
`SOURce:RANDom:SPACing:FREQuency` on page 674

Voltage Mode
Used to select the entry mode for the voltages of the individual sine-wave tones.

"Equal" All sinusoidal lines have the same amplitude. It is entered in the "Volt No1" parameter field.

"Define" A separate amplitude can be defined for each sinusoidal line.

Remote command:
`SOURce:FUNCtion:MODE` on page 673

Crest Factor
The peak value to rms value ratio (crest factor) of the signal can be influenced by the phase of the individual sinusoidal lines.

"Optimized" The ratio of peak value to RMS of the signal is minimized.

"Define Phase" The start phase of each sinusoidal line can be defined.

Remote command:
`SOURce:VOLTage:CRESt:MODE` on page 674

No of Sine
Used to set the number of sine-wave tones of the multi-sine-wave signal.

Remote command:
SOURce:MULTisine:COUNt on page 674

Freq No i
Sets the frequency of the Sine No i of the multi-sine-wave signal.

Based on the internal programming, several sine waves of the same frequency cannot have different phase references. The phase of the first sine wave is set, the phase information of the other ones is ignored and represented as non-changeable.

Remote command:
SOURce:FREQuency<n2> on page 668

Phase No i
Used to set the start phase of sine wave number i of the multi-sine-wave signal. This parameter field only appears if Define Phase is selected for Crest Factor.

Based on the internal programming, several sine waves of the same frequency cannot have different phase references. The phase of the first sine wave is set, the phase information of the other ones is ignored and represented as non-changeable.

Remote command:
SOURce:PHASe<n2> on page 672

Volt No i
Used to set the voltage of sine wave number i of the multi-sine-wave signal. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings "Output Type " on page 187 and "Max Voltage" on page 189 in the Generator Config panel.

Remote command:
SOURce:VOLTage<n2> on page 669

Total Gain
Used to set a gain factor which can be used to vary the total level of the multi-sine-wave signal. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings "Output Type " on page 187 and "Max Voltage" on page 189 in the Generator Config panel.

Remote command:
SOURce:VOLTage:TOTal:GAIN on page 675

Total Peak
Indicates the peak value of the multi-sine-wave signal.

Remote command:
SOURce:VOLTage:TOTal on page 674

Total RMS
Indicates the RMS of the multi-sine-wave signal (only in the analog generator).

Remote command:
SOURce:VOLTage:RMS on page 674

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field, see chapter 5.7, "Equalization", on page 265.

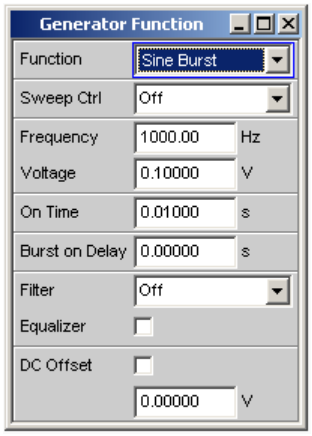
DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670
SOURce:VOLTage:OFFSet<n3> on page 670

5.6.4 Sine Burst

The generator generates a sine-wave signal, the amplitude of which changes periodically between high level (Voltage) during the burst duration (On Time) and zero level during the burst pause.



When generator settings have been changed or a measurement has been started, the burst starts with the positive sinusoidal half-wave of the burst duration (On Time). The "Burst On Delay" parameter is used to set a defined delay time.

SCPI command:

`SOURce:FUNCtion` on page 668

Sweep Ctrl
Used to enable the sweep system. The frequency and level of the burst signal can be varied within a selectable range from the start to the stop value. If one of these parameters is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

The individual sweep points are calculated linear or logarithmic between start and stop values or read out of a file.

The individual sweep points are automatically forwarded in a defined time grid or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

Frequency
Used to set the frequency of the sine wave. The value range depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

Remote command:
`SOURce:FREQuency<n2>` on page 668

Voltage
Used to set the level of the sine wave during the burst duration. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

Remote command:
`SOURce:VOLTage<n2>` on page 669

On Time
Used to set the burst duration. Entered as a fixed time or as a number of periods (cycles) of the sine wave frequency.

Minimum value: 1 Sample

Maximum value: 60 s – 1 Sample

With SINGLE, the burst signal is output once, with START the burst signal is output again with every completed measurement. In this operating mode, the set measuring time determines the repetition rate of the burst signal.

Remote command:
SOURce:ONTime on page 675

Burst on Delay
Used to set the delay time which must expire (after generator settings have been changed or a measurement has been started) before the generator can start the burst with the high level (Voltage). During this time, the signal is output with zero level.

Value range 0 to 60 s.

Remote command:
SOURce:ONTime:DELay on page 675

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The checkbox enables or disables this function.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

Remote command:
SOURce:VOLTage:EQUalize on page 670
MMEMory:LOAD:OEQualize on page 668

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:

SOURce:VOLTage:OFFSet<n3>:STATe on page 670

SOURce:VOLTage:OFFSet<n3> on page 670

5.6.5 Mod Dist

The generator generates a test signal for the intermodulation measurement in accordance with SMPTE and for the modulation factor analysis in accordance with IEC 268-3.

The signal consists of two sine waves: a low-frequency interfering signal and a high-frequency useful signal. The level of the interfering signal is 1 to 10 times as high as that of the useful signal.

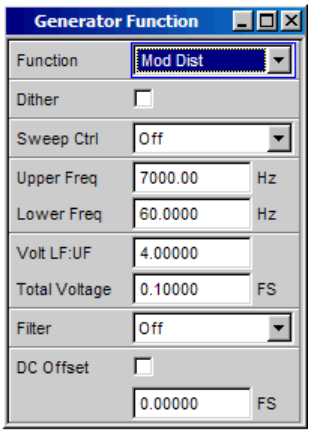
According to IEC 268-3, the frequency of the disturbance signal is between 0.5 and 1.5 octaves above the lower cutoff frequency of the instrument under test (60 Hz according to SMPTE).

According to IEC 268-3, the frequency of the useful signal is between 0.5 and 1.5 octaves below the lower cutoff frequency of the instrument under test (7 kHz according to SMPTE).

The frequency ratio of useful signal to noise signal should be greater than 8.

According to SMPTE, the level ratio of noise signal to useful signal must be 4:1; according to IEC 268-3, a ratio of 10:1 is also possible.

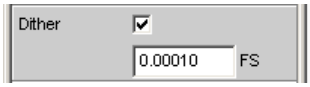
Panel of digital generator with Mod Dist function selected



SCPI command:

SOURce:FUNCtion on page 668

Dither



In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The checkbox enables or disables this function.

The parameter fields for Dither do not appear in the analog generator.

Remote command:
`SOURce:SINusoid:DITHer:STATe` on page 669
`SOURce:SINusoid:DITHer` on page 669

Sweep Ctrl
Used to enable the sweep system. The frequency of the useful signal (Upper Freq) or the total level (Total Voltage) of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between Start and Stop or read out of the file.

Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

Remote command:
`SOURce:SWEep:CONTrol` on page 688

Upper Freq
Used to set the frequency of the high-frequency useful signal.

Remote command:
`SOURce:FREQuency<n2>` on page 668

Lower Freq
Used to set the frequency of the low-frequency noise signal.

Remote command:
`SOURce:FREQuency<n2>` on page 668

Volt LF:UF
Used to set the level ratio of noise signal to useful signal as a dimension-less number.

Remote command:
`SOURce:VOLTage:RATio` on page 672

Total Voltage
Used to set the level of the total signal. The maximum RMS depends on the level ratio. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

Remote command:
`SOURce:VOLTage:TOTal` on page 674

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

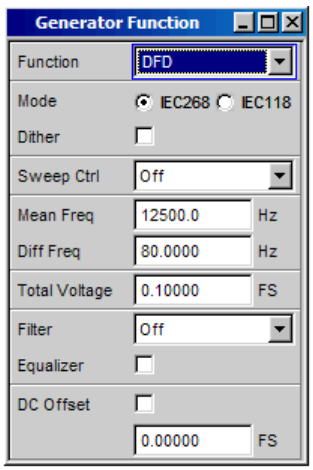
Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670
SOURce:VOLTage:OFFSet<n3> on page 670

5.6.6 DFD

The generator generates a test signal for the intermodulation measurement using the differential-tone method in accordance with IEC 118 or 268.

The signal consists of two very close sine waves of the same amplitude.

Panel of digital generator with DFD function selected



SCPI command:

SOURce:FUNCtion on page 668

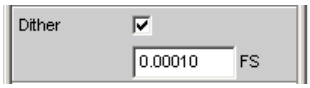
Mode
Used to select the entry mode for the frequencies of both signals.

"IEC 268" Entry of center frequency (Mean Freq) and difference frequency (Diff Freq). If a frequency sweep (for the x or z-axis) is selected, the center frequency is swept.

"IEC 118" Entry of upper frequency (Upper Freq) and difference frequency (Diff Freq). If a frequency sweep (for the x or z-axis) is selected, the upper frequency is swept.

Remote command:
`SOURce:FUNCtion:MODE` on page 673

Dither



In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The checkbox enables or disables this function.

The parameter fields for Dither do not appear in the analog generator.

Remote command:
`SOURce:SINusoid:DITHer:STATe` on page 669
`SOURce:SINusoid:DITHer` on page 669

Sweep Ctrl
Used to enable the sweep system. The center frequency (in the IEC 118 mode) or the upper frequency (in the IEC 268 mode) or the total level (Total Voltage) of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between Start and Stop or read out of the file.

Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

Remote command:
`SOURce:SWEep:CONTrol` on page 688

Mean Freq
Used to set the center frequency (in the IEC 268 mode).

Remote command:
`SOURce:FREQuency:MEAN` on page 676

Upper Freq
Used to set the upper frequency (in the IEC 118 mode).

Remote command:
`SOURce:FREQuency<n2>` on page 668

Diff Freq
Used to set the frequency difference of the two sine waves.

Remote command:
SOURce:FREQuency:DIFFerence on page 676

Total Voltage
Used to set the level of the total signal. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings "Output Type " on page 187 and "Max Voltage" on page 189 in the Generator Config panel.

Remote command:
SOURce:VOLTage:TOTal on page 674

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The checkbox enables or disables this function.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

Remote command:
SOURce:VOLTage:EQUalize on page 670
MMEMory:LOAD:OEQualize on page 668

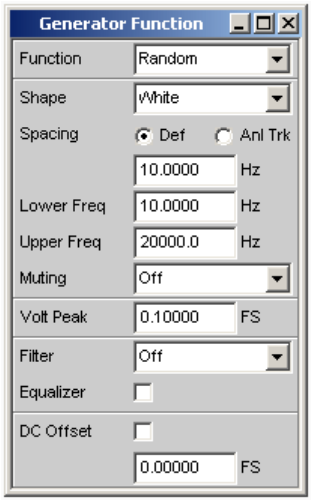
DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670
SOURce:VOLTage:OFFSet<n3> on page 670

5.6.7 Random

The generator creates a noise signal whose properties can be defined either in the time or frequency domain.



Several thousand equidistant sinusoidal lines in a selectable frequency domain

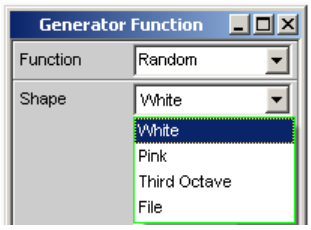
Special application:

If the frequency spacing of the sinusoidal lines generated here is identical to the analysis grid of the FFT, analysis can be performed without leakage in the FFT. It is therefore possible to obtain a selectivity of one line with the square-wave window. This type of generator/analyzer configuration allows frequency responses of DUTs to be determined in one go with high precision and selectivity.

SCPI command:

`SOURce:FUNCtion` on page 668

Shape



Defines the amplitude distribution of the signal spectrum within a selectable frequency domain.

"White" Time domain:
Uncorrelated white noise without periodicity is produced.
Frequency range:
Uncorrelated white noise without periodicity is produced.

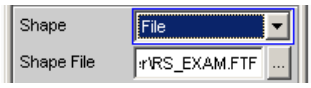
"Pink" Time domain:
To generate broadband pink noise that is free of periodicity, for the fixed frequencies between 11.025 kHz and 192 kHz (and thus for all configurable generator bandwidths), WAV files are available in the "User" directory. They can be played back using the "Play" generator function and are called `Pink_Noise_xxxxx.WAV`, where `xxxxx` designates the sampling rate in Hz.
Frequency range:
Pink noise. The amplitude of the sinusoidal lines between the upper and lower cutoff frequency is proportional to the function $\sqrt{1/f}$, and thus is attenuated by 3 dB per octave. Measurements performed using a third-octave analyzer return a uniform frequency spectrum.

"Third Octave" Frequency domain only:
Pink noise with a bandwidth of one third octave. The center frequency is adjustable.

"File" Frequency domain only:
The amplitude distribution is read from the file which is displayed in the next parameter field "Shape File".

Remote command:
`SOURce:RANDom:SHAPe` on page 677

Shape File



Frequency domain, only with the selection "Shape File"

File containing the amplitude distribution.

The ... button opens a browser that you can use to select the file.

"File format: "

ASCII file containing max. 8192 amplitude values which have to be entered as a sequence of numbers (value range FLOAT). The file must contain one line with the keyword "FREQUENCY_FILE" before the number sequence. Comment lines must begin with '#' and can be used anywhere in the file. No distinction is made between upper-case and lower-case characters. The recommended and preset file extension is '.FTF'. However, due to the keyword "FREQUENCY_FILE" which must always be entered, it is also possible to use any other file extension.

Beginning at 0 Hz, the amplitudes of the individual frequency lines must be entered as dimensionless numerical values. The numbers only indicate the amplitude ratio of the lines with respect to each other and not the output amplitude. It is set after the phase optimization according to the value defined in the "Volt Peak" parameter field. Since the ratio of peak value to RMS is calculated internally, it is also possible to enter the RMS.

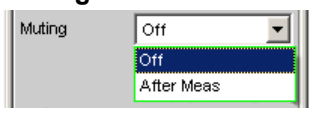
The frequency spacing is taken from the "Spacing" setting defined in the panel. Alternatively it can also be defined in the file. This requires specifying the keyword frequency_spacing (not case-sensitive), followed by the value in Hz. If this value is less than the minimum value: (sampling rate/16384), the minimum value is set.

Example: rs_exam.ftf in the directory D:\UPV\User

In addition to this file format, an equalization file (example: rs_exam.veq in the directory D:\UPV\User) can be loaded as a shape file. The amplitudes of individual frequency lines are set with respect to the equalization frequency response. The noise signal band is limited to the frequency range defined in the equalization file.

Remote command:
`MMEMory:LOAD:...`

Muting



This gives the option of switching off the generator when the measurement is completed and the generator signal is no longer needed.

"Off" The generator signal always remains switched on, independently of the measurement. This setting is necessary if the generator is operation without the analyzer, or if the device under test requires a long settling time.

"After Meas" The generator signal is switched off as soon as the (single) measurement is completed. When a continuous measurement is in progress, the generator signal also remains on continuously.
This setting is necessary if the measurement function or the device under test requires a low level before beginning the measurement, e.g. with the R&S UPP measurement function "Delay".
When the measurement is started, the generator signal is automatically switched on. Since no signal is present before the measurement is started, a potential delay of the device under test must be taken into account as "Start Cond Delay".

Remote command:
`SOURce:PLAY:MUTing` on page 678

Spacing

Used to set the frequency spacing. The frequency of each sinusoidal line is an integer multiple of this frequency spacing.

"Def" The frequency spacing can be freely defined.
Minimum value: Sampling rate/16384
If frequency spacing has been defined in the file, the line where a value would be entered for this setting is grayed out and the value is displayed instead.

"Anl Trk" The frequency spacing is adopted from the FFT set in the analyzer. This value depends on the sampling rate and the size of the FFT. This setting is only possible if an FFT or Post FFT is selected in the analyzer.
The line where a value would be entered for this setting is grayed out and the value is displayed.

Note: The finest frequency grid corresponds to an FFT size of 16 k. ARB files labeled "pseudoRandomxxxk.arb" are available for measuring longer FFTs – and, therefore, smaller frequency grid – in the "User" folder, whereby "xxx" is the FFT size expressed in k, to which the frequency grid of the generator is dimensioned. The prerequisite is that the generator and analyzer are operated at the same sampling rate/same analog bandwidth.

Remote command:
`SOURce:RANDom:SPACing:MODE` on page 674
`SOURce:RANDom:SPACing:FREQuency` on page 674

Lower Freq
Used to define the lower frequency limit of the noise signal if Shape is set to White or Pink.

Remote command:
`SOURce:RANDom:FREQuency:LOWer` on page 677

Upper Freq
Used to define the upper frequency limit of the noise signal if Shape is set to White or Pink.

Remote command:
`SOURce:RANDom:FREQuency:UPPer` on page 677

Mean Freq
Used to set the center frequency in the case of third-octave noise.

Remote command:
`SOURce:FREQuency:MEAN` on page 676

Volt Peak
Used to enter the peak value of the noise signal. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

The peak value to rms value ratio of the signal (crest factor) is minimized. If the noise is defined in the time domain, the selected distribution function for amplitude determines the crest factor.

Remote command:
`SOURce:VOLTage:TOTal` on page 674

Volt RMS
Used to enter the RMS of the noise signal (only in the analog generator). The peak value to rms value ratio of the signal (crest factor) is minimized. If the noise is defined in the time domain, the selected distribution function for amplitude determines the crest factor.

Remote command:
SOURce:VOLTage:RMS on page 674

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The checkbox enables or disables this function.

These parameter fields are hidden if time-domain noise (Domain Time) is selected.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

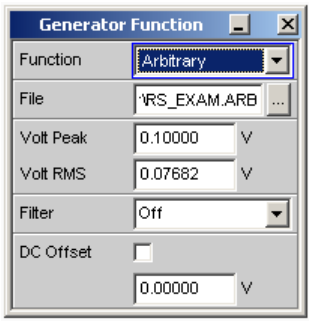
Remote command:
SOURce:VOLTage:EQUalize on page 670
MMEMory:LOAD:OEQualize on page 668

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:
SOURce:VOLTage:OFFSet<n3>:STATe on page 670
SOURce:VOLTage:OFFSet<n3> on page 670

5.6.8 Arbitrary



The generator generates a freely definable curve shape which is read out from a file as a sequence of samples. The maximum length is 262144 (256 k) samples. When output, the curve is repeated continuously in an unbroken sequence. If a measurement is restarted (Start button), the curve starts again from the beginning of the file. The individual samples are output at the sampling rate selected in the generator.

SCPI command:

`SOURce:FUNCtion` on page 668

File

File from which the curve shape is read.

The ... button opens a browser that you can use to select the file.

File format:

ASCII file with max. 524288 (512 k) samples. The individual samples are entered as a sequence of numbers (value range -1.0 to +1.0). The file must contain one line with the keyword "TIMETAB_FILE" before the number sequence. Comment lines must begin with '#' and can be used anywhere in the file. No distinction is made between upper-case and lower-case characters. The recommended and preset file extension is '.ARB'. However, due to the keyword "TIMETAB_FILE" which must always be entered, it is also possible to use any other file extension.

The numerically highest value (Maximum) is output with the peak voltage set in the "Volt Peak" entry field; the other samples are level-controlled according to their ratio to the maximum. Since the ratio of peak value to RMS is calculated internally from the samples, it is also possible to enter the RMS.

Example: rs_exam.arb in the `D:\UPV\User` directory

Remote command:

`MMEMory:LOAD:ARBitrary` on page 678

Volt Peak
Used to enter the peak value of the arbitrary signal. The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings "Output Type " on page 187 and "Max Voltage" on page 189 in the Generator Config panel. The peak value and RMS are interlinked by means of the crest factor.

Remote command:
`SOURce:VOLTage:TOTal` on page 674

Volt RMS
Used to enter the RMS of the arbitrary signal (only in the analog generator). The peak value and RMS are interlinked by means of the crest factor.

Remote command:
`SOURce:VOLTage:RMS` on page 674

Filter

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
`SOURce:FILTer` on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

Remote command:
`SOURce:VOLTage:OFFSet<n3>:STATe` on page 670
`SOURce:VOLTage:OFFSet<n3>` on page 670

5.6.9 Play

This function enables any WAV file to be replayed. In conjunction with the "HDMI" generator instrument, Dolby Digital AC3 files and Dolby Digital® Plus EC3 files can also be played back. Coded audio signals are not decoded, but instead are played back to the DUT unchanged.

This generator function covers the following cases:

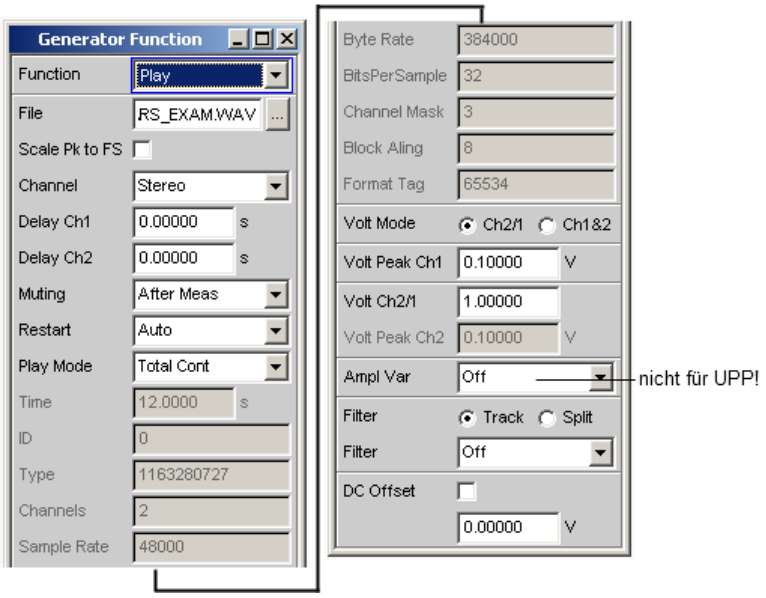
- Offline analysis of data streams that have been recorded using a suitable recording instrument.

- Playing back specific speech and music signals for special measurements in mobile radio or for gearing aids,
- Playing back specific test sequences, such as for external sweeps.
- Data source for coded audio signals that are intended to be decoded by a connected DUT.

For offline analysis, the generator is operated not with the DUT, but directly (internally, if possible) using the R&S UPP analyzer, which then carries out all desired measurements. All available interfaces (preferably digital) can be used for this. Thus a previously analog measurement signal can be examined losslessly, for example during offline analysis, via one of the optional R&S UPP digital interfaces.

Playback starts immediately after successfully loading the WAV file. Every time a generator setting is changed or the START button is pressed, playback restarts.

Panel of the analog generator for the Play function.



This panel also displays information about the WAV header. The meanings attached to this information are dependent on the format (standard or extended) and may be inferred from the WAV specification.

SCPI command:

`SOURce:FUNCtion` on page 668

File
For entering the drive, path and file name of the WAV file from which the waveform will be read.

The ... opens a browser that you can use to select the WAV file.

Since the file is read online during playback, only data media having a high transfer rate are suitable. These include data partition of the hard drive or a network drive with at least 100 Mbit/s. USB sticks and drives should be used only for files of less than 0.5 Msamples.

When the file name has been entered, the WAV file header information is displayed in the panel and playback starts. This process also checks whether the configured sampling rate (or bandwidth in the analog generator) matches the sampling rate stored in the WAV file. If necessary, a warning is displayed; however, the sampling rate used is always that configured in the Config panel of the generator.

Note: In the analog generator, the sampling rate is calculated from the configured bandwidth (see "Bandwidth" on page 292). The special Play Auto setting causes the sampling rate stored in the WAV file to be used, thus making it possible to play back even WAV files with uneven sampling rates (e.g. 44.1 kHz) in the analog generator.

Remote command:
`MMEMory:LOAD:ARBitrary` on page 678

Scale Pk to FS

Enables optional scaling up of samples in order to obtain full control.

This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

"Deactivated:" The samples from the WAV file are output without change. This mode enables the WAV file to be loaded faster, since it does not need to be fully scanned.
WAV files that are already fully controlled should be used in this mode.

"Activated:" The WAV file is searched for the highest sample and is scaled during playback in such a way that the highest occurring sample reaches exactly to full scale and is therefore output with the specified peak voltage.
In the case of poorly controlled WAV files, this mode improves the dynamic response of the analog generator.

Note: Because in order to determine the scaling factor, the entire WAV file must be searched when loading, the loading process – particularly for long files – takes somewhat longer in this mode.

Remote command:
`SOURce:PLAY:SCALepktofs` on page 679

Channel

Only for stereo WAV files; enables a single WAV channel to be played back as a mono signal on both generator channels.

For mono WAV files, this selection does not apply; they are always output on both generator channels.

Note: Whether a signal is actually output at both generator channels depends, as for all generator signals, on the menu item of the same name in the Generator Config panel.

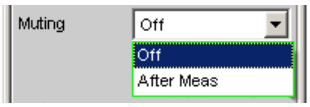
"Mono Left" The left WAV channel is output on all active generator channels.

"Mono Right" The right WAV channel is output on all active generator channels.

"Stereo" The left WAV channel is output on generator channel 1, the right on channel 2.

Remote command:
`SOURce:PLAY:CHANnel` on page 678

Muting



This gives the option of switching off the generator when the measurement is completed and the generator signal is no longer needed.

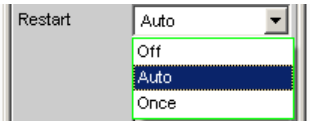
"Off" The generator signal always remains switched on, independently of the measurement. This setting is necessary if the generator is operation without the analyzer, or if the device under test requires a long settling time.

"After Meas" The generator signal is switched off as soon as the (single) measurement is completed. When a continuous measurement is in progress, the generator signal also remains on continuously.
This setting is necessary if the measurement function or the device under test requires a low level before beginning the measurement, e.g. with the R&S UPP measurement function "Delay".
When the measurement is started, the generator signal is automatically switched on. Since no signal is present before the measurement is started, a potential delay of the device under test must be taken into account as "Start Cond Delay".

Remote command:
`SOURce:PLAY:MUTing` on page 678

Restart

Determines the behavior of the play file with generator settings.



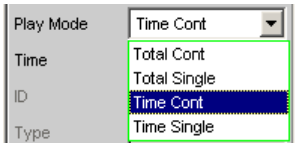
"Off" The signal is muted immediately.
If the level changes, the playback of the play file is not interrupted. Level changes include the settings "Volt Peak Ch1", "Volt Peak Ch2", "Volt Ch2/1", "Filter" and "DC Offset". For all other generator settings that change the physical properties of the signal, the signal is muted. Only the activation of the item "Once" or START causes the playback of the play file to restart.

"Auto" The playback of the play file is restarted with **any** setting in the generator panel.

"Once" Forces the restart of the playback of the play file only once.

Remote command:
`SOURce:PLAY:RESTart` on page 679

Play Mode
Determines the playback mode of the loaded WAV file.



"Total Cont" The complete WAV file is played back in a loop; when the end of the file is reached, playback jumps back to the beginning of the file without interruption.

Note: During the jump back, the signal normally becomes discontinuous, which for pure sine-wave signals, is visible as noise of the spectrum close to the carrier.

"Total Single" The complete WAV file is played back once, after which the generator is muted.

"Time Cont" The beginning of the WAV file is played back in a loop; after the playback time selected in the next menu line expires, playback jumps back to the beginning of the file without interruption.

"Time Single" The beginning of the WAV file is played back once; after the playback time selected in the next menu line expires, playback stops and the generator is muted.

Remote command:
`SOURce:PLAY:MODE` on page 678

Time
Used to display or enter the playback duration.

Since the R&S UPP cannot output WAV files online, a maximum of 16 Msamples of a WAV file can be played. The maximum playback duration is calculated using the number of samples in the WAV file and the sampling rate. With a sampling rate of 48 kHz, this results in a maximum playback time of approx. 350 s.

Depending on the selected Play Mode, the playback duration can be
- displayed ("Play Mode Total …") if the intention is to play back the WAV file in full;
- entered ("Play Mode Time …") in order to reset or prematurely interrupt playback.

Note: If the sampling rate is increased subsequently, the playback duration may be reduced.

Remote command:
`SOURce:PLAY:TIME` on page 679

Volt Mode
This determines the setting of the level for channels 1 and 2.

The maximum value depends on the configured DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

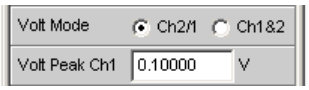
This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

"Ch2/1" The level of channel 2 is at a fixed ratio to the level of channel 1 and can be set as a f actor with the command "Volt Ch2/1".

"Ch1&2" The level can be set separately for Channel 1 and 2.

Remote command:
`SOURce:VOLTage:SELect` on page 673

Volt Peak Ch1
Level of Channel 1.



This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

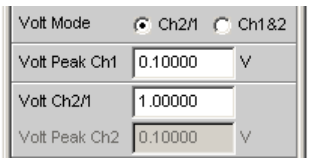
Remote command:
`SOURce:VOLTage<n2>` on page 669

Volt Peak Ch2
Level of channel 2 in "Volt Mode Ch1&2"

This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

Remote command:
`SOURce:VOLTage:CH2Stereo` on page 672

Volt Ch2/1
Ratio of the level of both channels relative to channel 1 in "Volt Mode Ch2/1".



This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

Remote command:
SOURce:VOLTage:RATio on page 672

Filter

The filter can be selected for both channels together (Track) or separately from each other (Split).

This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

Remote command:
SOURce:FILTer:CHANnels on page 671

Filter / Filter Ch1

Common filter for channel 1 and channel 2, if "Track" filter was selected. Filter for channel 1, if "Split" filter was selected.

This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
SOURce:FILTer on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Filter Ch2
Filter for channel 2, if "Split" filter was selected.

The generator signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

Remote command:
SOURce:STEReo<n2>:FILTer on page 740

DC Offset

A common-mode voltage offset is superimposed on the generator signal. This decreases the maximum possible AC voltage. The checkbox enables or disables this function. The value configured for the offset voltage is always displayed.

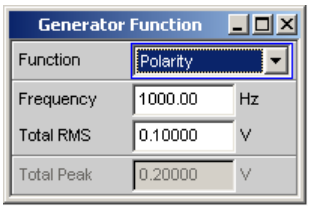
This parameter field does not appear if coded audio formats are played back; see note "Audio Format" on page 216.

Remote command:

SOURce:VOLTage:OFFSet<n3>:STATe on page 670

SOURce:VOLTage:OFFSet<n3> on page 670

5.6.10 Polarity



The generator generates a test signal for polarity measurement. This measurement is used to check the polarity of the input signal transmitted by the DUT.

SCPI command:

SOURce:FUNCtion on page 668

The test signal consists of two sine waves, one of which is a fundamental and the other a harmonic, having the same amplitude in each case. The phase of the harmonic is selected so that the positive peak value is greater than the negative.

Frequency
Used to set the frequency of the fundamental.

Remote command:

SOURce:FREQuency<n2> on page 668

Total RMS
Used to set the level of the signal. In the analog generator, the maximum total voltage depends on the settings "Output Type " on page 187 and "Max Voltage" on page 189 in the Generator Config panel.

Remote command:

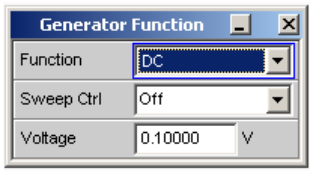
SOURce:VOLTage<n2> on page 669

Total Peak
Used to display the peak value of the signal.

Remote command:

SOURce:VOLTage:TOTal on page 674

5.6.11 DC (Direct-Current Voltage)



The generator generates a DC voltage signal. Unlike the DC offset, it is possible to sweep this DC voltage.

SCPI command:

`SOURce:FUNCtion` on page 668

Sweep Ctrl
Used to enable the sweep system. The DC voltage can be varied within a selectable range from the start to the stop value. If the level is selected as the x-axis, the measured values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between Start and Stop or read out of the file.

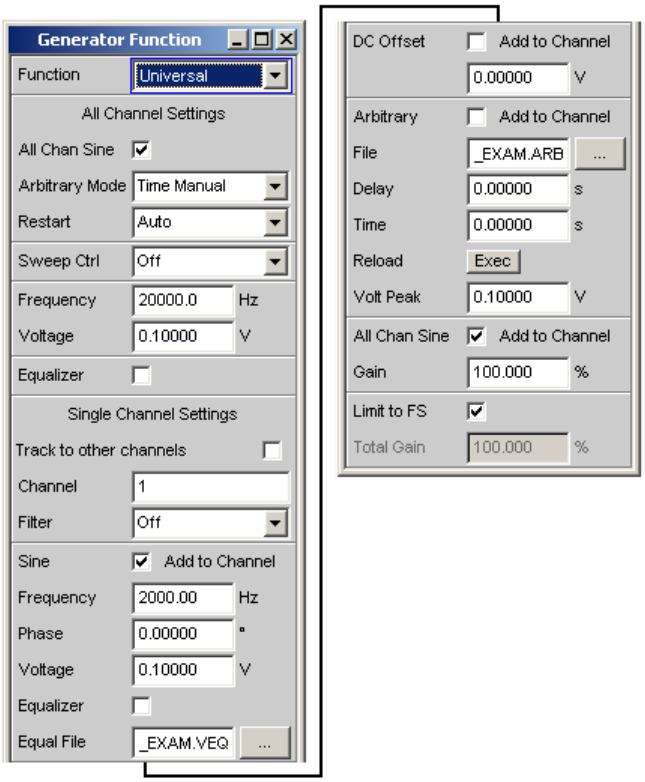
Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described, see chapter 5.9, "Sweeps", on page 271.

Remote command:
`SOURce:SWEep:CONTrol` on page 688

Voltage
DC voltage level. In the analog generator, the maximum value depends on the settings "Output Type " on page 187and "Max Voltage" on page 189 in the Generator Config panel.

Remote command:
`SOURce:VOLTage:TOTal` on page 674

5.6.12 Universal



The "Universal" generator function is available

- in the 2-channel **"Analog"** generator instrument, with installed 8-channel R&S UPP B8 (multichannel audio generator) option.
- with installed R&S UPP B2 (digital audio interface) option in the 2-channel **"Digital Audio"** generator instrument, with installed 8-channel R&S UPP B8 (multichannel audio generator) option.
- at installed R&S UPP B2 (digital audio interface) option in the 2-channel **"I2S"** generator instrument, with installed R&S UPP B4 (HDMI and digital audio interfaces) option in the 8-channel **"I2S"** generator instrument.
- with installed R&S UPP B4 (HDMI and digital audio interface) option and the 8-channel **"HDMI"** generator instrument.

The "Universal" function provides a generator signal for 2 or 8 channels; this signal is configured using common settings for all channels as well as individually for each channel. The corresponding panel areas are identified by the headings "All Channel Settings" and "Single Channel Settings".

Common to all channels is a noise signal (dither), a higher-level sine wave that can also be swept in frequency and/or amplitude, and the option for equalizing the higher-level sine wave and the playback time of the arbitrary files.

Individually for every individual channel, it is possible to set a filter, a sine wave, an equalizer acting on its level, a DC Offset, an arbitrary signal, a delay with which an

arbitrary file is played back, as well as the higher-level sine wave with a percentage share.

The overall signal for every individual channel in the case of

- **digital generators** is limited to 1 FS with "Limit to FS" or leveled to a maximum of 1 FS by applying an attenuation or gain.
- **analog generators** is leveled with "Limit to Max" to the maximum possible voltage or the desired voltage.

Hence, the signal for the "Universal" generator function consists of several signal components and is referred to as "overall signal" in the following descriptive section.

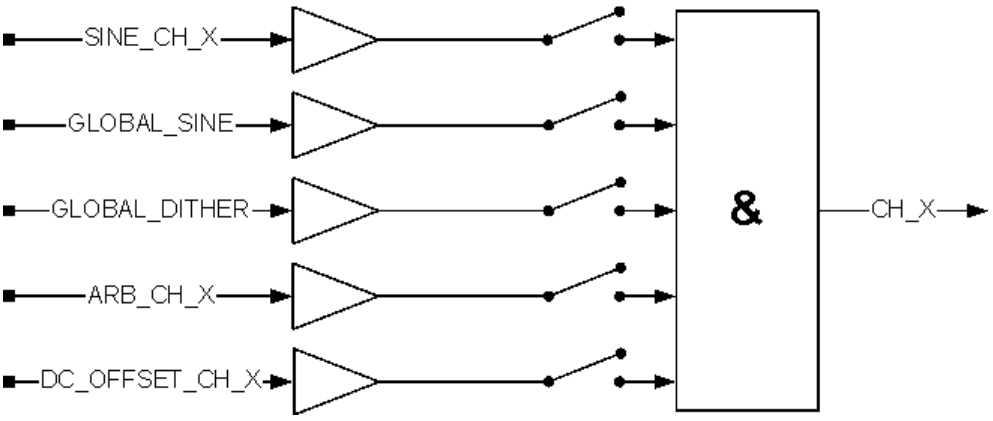
If the sum of the individual signal components – i.e. the overall signal, 1 FS (digital) or the maximum possible voltage (analog) was exceeded – the overall signal is limited to 1 FS or the maximum possible voltage with the "Limit to FS" or "Limit to Max" parameter field. If "Limit to FS" or "Limit to Max" is deactivated, it is possible to freely enter a level adjustment (attenuation or gain) of the overall signal with the "Total Gain" parameter field up to a maximum of 1 FS or to the maximum possible voltage. If the level of a signal component that caused the overall signal to be cut to 1 FS or to the maximum possible voltage is reduced again, then the "Total Gain" value that led to the attenuation of the overall signal is retained. This behavior applies equally to all signal components and is not mentioned in their description.

If the overall signal was limited to 1 FS or the maximum possible voltage, then the "Voltage", "DC Offset" and "Arbitrary Peak" level values can be viewed only as ratios to each other and allow only an indirect inference to the actual level components in the overall signal!

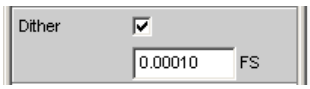
SCPI command:

`SOURce:FUNCtion` on page 668

The following figure illustrates the interplay of the individual signal components:



Dither



Only available in the digital generator instruments.

A **noise component** with adjustable amplitude can be superimposed on the overall signal. This setting reduced the maximum level of the other signal components that can be entered.

The checkbox enables or disables this function.

Remote command:
`SOURce:SINusoid:DITHer:STATe` on page 669
`SOURce:SINusoid:DITHer` on page 669

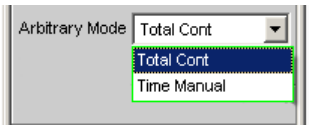
All Chan Sine

"Deactivated:" The higher-level sine wave is neither being generated nor being provided. All concerning parameter fields disappear.

"Activated:" The higher-level sine wave is being generated and provided and added channel-based to the overall signal with a percentage via the "Gain" parameter field if the check mark is set in the "All Chan Sine" parameter field at the end of the panel.

Remote command:
`SOURce:ACHSine:STATe` on page 681

Arbitrary Mode



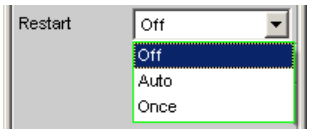
Operating mode of the arbitrary signal components (ARB and WAV files) within the universal generator function.

"Total Cont" All active arbitrary signal components are played back with the same fixed playback time. This is yielded by the longest sum of active arbitrary files and the associated delay and is displayed in the "Arbitrary" section in the "Time" parameter field. After this time expires, the playback of the arbitrary components starts over from the beginning, if necessary after the delay of the individual channel expires.
Each time a generator setting is changed, the arbitrary signal is automatically recalculated, loaded and restarted. Since the loading process is very time-consuming (approx. 1/3 of the total playback time at a sampling rate of 48 kHz), this mode should be used only for short arbitrary files.

"Time Manual" The combined playback time of all active arbitrary signal components (including delay) can be selected by the user in the "Time" parameter field. Longer arbitrary files are clipped; shorter files are attached in a loop. After this time expires, the arbitrary components are muted. Changes in the "Arbitrary" section are not automatically passed on to the hardware, but instead have to be explicitly loaded by the user by pressing the "Reload Exec" button. Therefore the arbitrary signal component of all channels can be completely entered at first, without being slowed down by a loading process.

Remote command:
`SOURce:ARBitrary:MODE` on page 681

Restart



This menu item enables the generator to be stopped or started in a targeted manner.

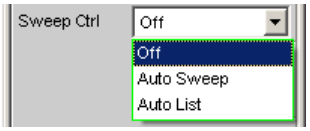
"Off" The generator is deactivated. The generator is not restarted upon pressing the Single button or changing the generator's signal form or configuration. The generator is restarted only by the Start button or by selecting "Restart = Once".

"Auto" The generator (and the measurement) is restarted. The generator is automatically restarted upon pressing the Start button or changing the generator's signal form or configuration. Level settings are executed without restarting, likewise by pressing the Single button.

"Once" The generator (and the measurement) is started once, then the generator assumes its previous state ("Off" or "Auto"). The generator continues running until a change is made to the generator's signal form or configuration, or "Restart = Off" is explicitly selected.

Remote command:
`SOURce:PLAY:RESTart` on page 679

Sweep Ctrl



Used to enable the sweep system for the higher-level sine wave. Frequency and/or level of the signal can be varied from start to stop value within a selectable range. If frequency or level is selected as the x-axis, the measured values can be displayed as a curve in the "Sweep Graph" graphical window.

Sweep points: With the "Auto Sweep" setting linear or logarithmic between Start and Stop or with the "Auto List" setting from a file.

Forwarding: Automatic in a defined time frame or synchronized to the measuring time of the analyzer. All setting parameters of the sweep system are described in detail in chapter 5.9, "Sweeps", on page 271.

This parameter field appears only if the check mark of "All Chan Sine" is set in the "All Channel Settings" panel area.

Remote command:
SOURce:SWEep:CONTrol on page 688

Frequency
Used to set the frequency of the higher-level sine wave. The value range depends on the digital clock rate set in the Generator Config panel.

This parameter field appears only if the check mark of "All Chan Sine" in the "All Channel Settings" panel area is set and is also dependent on the setting in the "Sweep Ctrl" parameter field.

Remote command:
SOURce:ACHSine:FREQuency on page 681

Voltage
Used to set the level of the higher-level sine wave. A percentage of this level, which can be set via the "Gain" parameter field, can be added to the overall signal. If the level of the higher-level sine wave is changed, it affects the individual channels equally according to the Gain factor.

This parameter field appears only if the check mark of "All Chan Sine" in the "All Channel Settings" panel area is set and is also dependent on the setting in the "Sweep Ctrl" parameter field.

Remote command:
SOURce:ACHSine:VOLTage on page 681

Equalizer

The higher-level sine wave is precorrected in the frequency band based on the entries in the "Equal File".

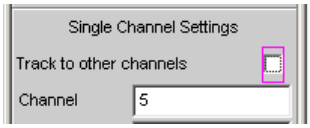
The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

The checkbox enables or disables this function.

This parameter field appears only if the check mark of "All Chan Sine" is set in the "All Channel Settings" panel area.

Remote command:
SOURce:VOLTage:EQUalize on page 670
MMEMory:LOAD:OEQualize on page 668

Track to other channels



"Deactivated:" The "Channel" parameter field underneath it can be edited, and the change of a parameter underneath it exclusively affects the channel identified by "Channel".

"Activated:" At the time of switching from deactivated to activated, all parameters of the currently displayed channel is copied to all the other channels so that completely identical data records are present for all 8 channels. The "Channel" parameter field underneath it is no longer editable. A change in one of the parameters underneath it no longer affects an individual channel, but **all 8 channels at the same time**.

Remote command:
`SOURce:SCHSettings:TTOChannels` on page 684

Channel
This parameter field is editable if the "Track to other channels" parameter field above it is deactivated.

The value designates one of 8 channels whose parameter set is displayed below "Channel" in the panel. Changes to these parameters refer exclusively to the channel indicated here. Changing the number in this field allows a **quick overview** of the parameters of all channels.

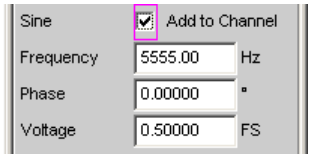
Remote command:
`SOURce:SCHSettings:CHANnel` on page 684

Filter

The overall signal is filtered in the time domain. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. All level settings apply to the unfiltered signal

Remote command:
`SOURce:MCHannel<n2>:FILTer` on page 740
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Sine



The channel-based sine-wave signal is generated based on the parameter fields "Frequency", "Phase" and "Voltage" underneath it and added to the overall signal.

The checkbox enables or disables this function.

Remote command:
`SOURce:MCHannel<n2>:SINE:STATe` on page 684

Frequency
Frequency of the channel-based sine-wave signal

Remote command:
SOURce:MCHannel<n2>:SINE:FREQuency on page 683

Phase
For signals with the exact same frequency and **activated higher-level sine-wave signal**, a two-tone signal is generated in every channel at which the channel-based sine wave has the specified phase with respect to the higher-level sine-wave signal.

With **deactivated higher-level sine-wave signal**, the channels have the difference of their phase entries as phase relationship among each other.

Remote command:
SOURce:MCHannel<n2>:SINE:PHASe on page 684

Voltage
Level of the channel-based sine-wave signal

Remote command:
SOURce:MCHannel<n2>:SINE:VOLTage on page 684

Equalizer

The content of the equalization file affects the adjustable level range of the channel-based sine wave. If the selection of "Equalization" results in a level increase, it leads to the cutoff of level values if the overall signal of 1 FS is exceeded.

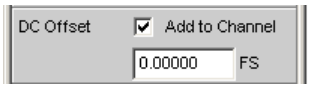
The channel-based sine-wave signal is precorrected in the frequency band based on the entries in the "Equal File".

The checkbox enables or disables this function.

The ... button opens a browser in which you can select the equalizer file, refer also to chapter 5.7, "Equalization", on page 265.

Remote command:
MMEMory:LOAD:MCHannel<n3>:SINE:EQUalize on page 681
SOURce:MCHannel<n2>:SINE:EQUalize:STATe on page 683

DC Offset

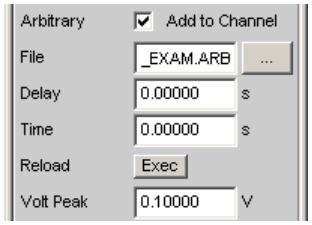


A DC voltage is added to the overall signal.

The checkbox enables or disables this function.

Remote command:
SOURce:MCHannel<n2>:SINE:OFFSet:STATe on page 683
SOURce:MCHannel<n2>:SINE:OFFSet:VOLTage on page 684

Arbitrary



A signal with random frequency and shape and the level specified in "Volt Peak" is added to the overall signal. The signal is determined by the "File" waveform file.

The checkbox enables or disables this function.

Remote command:

`SOURce:MCHannel<n2>:SINE:ARBitrary:STATe` on page 683

`MMEMory:LOAD:MCHannel<n3>:SINE:ARBitrary` on page 680

`SOURce:MCHannel<n2>:SINE:ARBitrary:VOLTage` on page 683

Delay

Indicates the delay with which the arbitrary file is played back. This time can be set individually for each channel and can be used, for example, to compensate for sound propagation times.

Remote command:

`SOURce:MCHannel<n2>:SINE:ARBitrary:DELay` on page 683

Time

Only available if "Arbitrary Mode" in the upper part of the panel is set to "Time manual". "Time" is higher-level for all channels and indicates the how long the arbitrary file is played back. If the playback time of the file content is the same or longer than this time, the output is ended or canceled after this time. If the playback time of the file content is shorter, the file content is output in a loop until this time is reached. Afterwards, zero samples are output.

The "Total Cont" setting makes "Time" into a pure display function, which shows the time of the longest sum of the active arbitrary files and the associated delays.

Remote command:

`SOURce:ARBitrary:TIME` on page 682

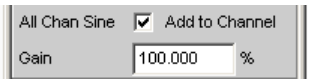
Reload

Causes (re-)loading of the arbitrary signal components.

Only available if "Arbitrary Mode" in the upper part of the panel is set to "Time manual". Each time parameters of the "Universal" generator function are modified, time-intensive signal processing processes would have to be initiated in the firmware of the R&S UPP, which would significantly impede the operation. The reload function enables all settings to be carried out instantaneously. In doing so, only the time-intensive loading processes of the arbitrary signal components are omitted. For the changes to the Arbitrary section to take effect, the user must explicitly call up the loading process **once** – after completing all arbitrary settings.

Remote command:
`SOURce:ARBitrary:RELoad` on page 682

All Chan Sine



This parameter field appears only if the check mark of "All Chan Sine" is set in the "All Channel Settings" panel area.

"Deactivated:" The higher-level sine wave is **not** added to the overall signal in the indicated channel. The following "Gain" parameter field serves as default setting and takes effect only if the check mark is set.

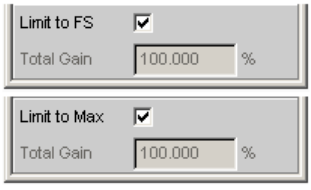
"Activated:" The higher-level sine wave is added to the overall signal in a percentage that is determined with the following "Gain" parameter field.

Remote command:
`SOURce:MCHannel<n2>:ACHSine:STATe` on page 682
`SOURce:MCHannel<n2>:GAIN` on page 682

Gain
If the "All Chan Sine" check mark in the parameter field above it is set, a percentage from the level of the higher-level sine wave is added to the overall signal.

Remote command:
`SOURce:MCHannel<n2>:ACHSine:STATe` on page 682
`SOURce:MCHannel<n2>:GAIN` on page 682

Limit to Max
The text in the panel changes between **Limit to FS** (digital) and **Limit to Max** (analog) in accordance with the selected generator. The overall signal is clipped to a maximum of 1 FS for the **digital generators** and to the maximum possible voltage or desired voltage for the **analog generators**.



"Deactivated:" With the subsequent "Total Gain" parameter field, the overall signal can be attenuated or amplified.

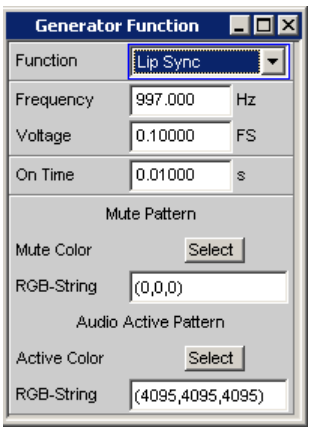
"Activated:" The overall signal is limited to 1 FS or the maximum possible voltage.

Remote command:
SOURce:MCHannel<n2>:LIMittofs on page 683

Total Gain
This parameter field can be edited only if "Limit to FS" or "Limit to Max" is deactivated and permits the overall signal to be leveled. The upper limit value is calculated so that the level of the overall signal cannot exceed 1 FS for digital generators or the maximum possible voltage for analog generators.

Remote command:
SOURce:MCHannel<n2>:TOTal:GAIN on page 684

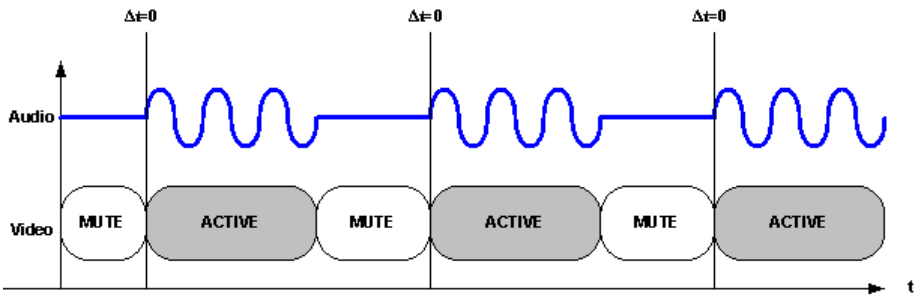
5.6.13 Lip Sync



Available only with the R&S UPP K45 (expanded audio/video measurements) option.

The Lip Sync generator function is automatically activated if "Video Source" is set to "Intern" and "Pattern" to "Lip Sync" in the HDMI generator.

The "Lip Sync" generator function generates a sine burst signal of variable frequency, length, periodicity and amplitude. With the start of the burst signal, the picture content of the HDMI signal is set to the color of the "Audio Active Pattern" for the duration of the burst. During the breaks, in which no audio signal is output, the picture information changes to the "Mute Pattern". This change creates a trigger condition for the analyzer with which an offset can be measured between picture and sound. The illustration below shows the association.



Based on the fixed time relationship of audio and video data, the delay of the picture compared to the sound and vice versa can be measured within a device under test in the analyzer.

SCPI command:

SOURce:FUNCtion on page 668

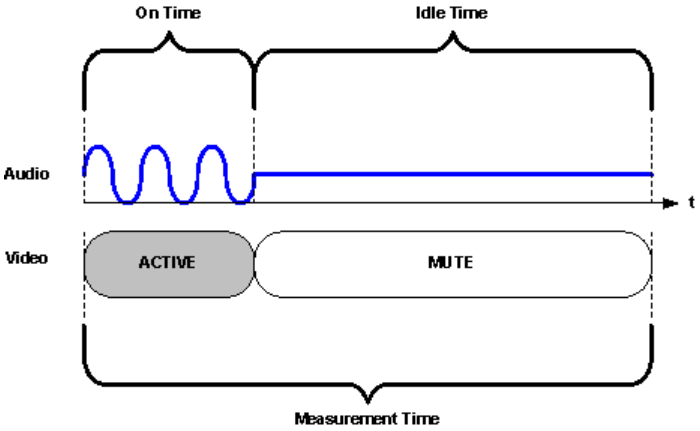
Frequency
Frequency of the generated sine burst signal.

Remote command:
SOURce:FREQuency<n2> on page 668

Voltage
Amplitude of the sine burst.

Remote command:
SOURce:VOLTage<n2> on page 669

On Time
Determines the periodicity of Lip Sync pattern together with the "Meas Time" set in the corresponding analyzer measuring function "Lip Sync". The following illustration shows the time association.

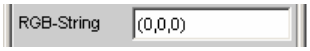


Remote command:
SOURce:ONTime on page 675

Mute Color
Color to be output if no audio data are present.

The color can be configured using the color selection dialog. In the following parameter field, the colors are always shown as decimal equivalents of 12-bit long numeric values. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

RGB string
Color to be output if no audio data are present.

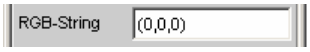


The color selection from the above color selection dialog above is mapped as RGB string and can be configured here, if necessary. In each case, the decimal equivalent of 12-bit long numeric values is mapped. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

Active Color
Color to be output if audio data are output.

The color can be configured using the color selection dialog. In the following parameter field, the colors are always shown as decimal equivalents of 12-bit long numeric values. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

RGB string
Color to be output if audio data are output.



The color selection from the above color selection dialog above is mapped as RGB string and can be configured here, if necessary. In each case, the decimal equivalent of 12-bit long numeric values is mapped. With a lower color depth in the "Color Depth" selection field, the corresponding LSBs are not transmitted, but set to 0.

5.7 Equalization

The generator can be given a predefined frequency response using a table containing frequency points and the associated gain factors. The set amplitude of the generator is automatically changed as a function of frequency in accordance with the table.

Equalizer
Activating/deactivating the precorrection.

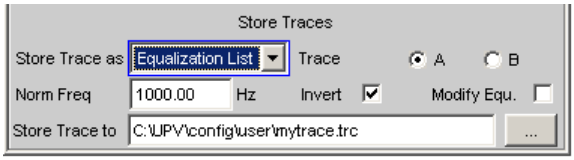
Remote command:
`SOURce:VOLTage:EQUalize` on page 670

Equal File
Selection of the table.

The ... button opens a browser that you can use to select the precorrection file.

The table must be saved in a file in a particular format (see example `RS_EXAM.VEQ` in the `d:/upv/user` folder), which can be loaded in the "Equalization" parameter field in the Generator Function panel.

The file can also be created from a measured curve or a curve imported from a file by storing the trace as Equalization List in the Display Config panel.



A number of different settings are available which are explained under "Store Trace as" on page 531.

Remote command:
`MMEMory:LOAD:OEQualize` on page 668

5.8 Protocol Generator

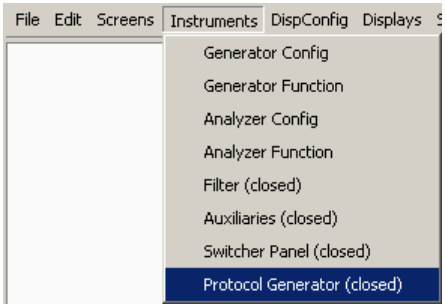
The **R&S UPP B2 (digital audio interfaces) option** in conjunction with the **R&S UPP K21 (digital audio protocol) option** enables the "Digital Audio" generator instrument to be used for generating and analyzing the channel status data in the data stream of the digital audio interface according to the IEC 60958-3 standard for the Consumer Mode and IEC 60958-4 or AES3 for the Professional Mode.

The **R&S UPP B4 (HDMI and digital audio interface) option in conjunction with the R&S UPP K21 (digital audio protocol)** option enables the "Digital Audio" generator instrument to be used for generating and analyzing the channel status data in the data stream of the digital audio interface according to the IEC 60958-3 standard for the Consumer Mode and IEC 60958-4 or AES3 for the Professional Mode.**In addition**, the B4 option with the "HDMI" generator instrument enables the generation and analysis of the channel status data according to the IEC standard 60958-3 **only for the Consumer Mode**. For HDMI, the audio-relevant data are embedded in the channel status bytes 0 to 4 of the HDMI stream header.

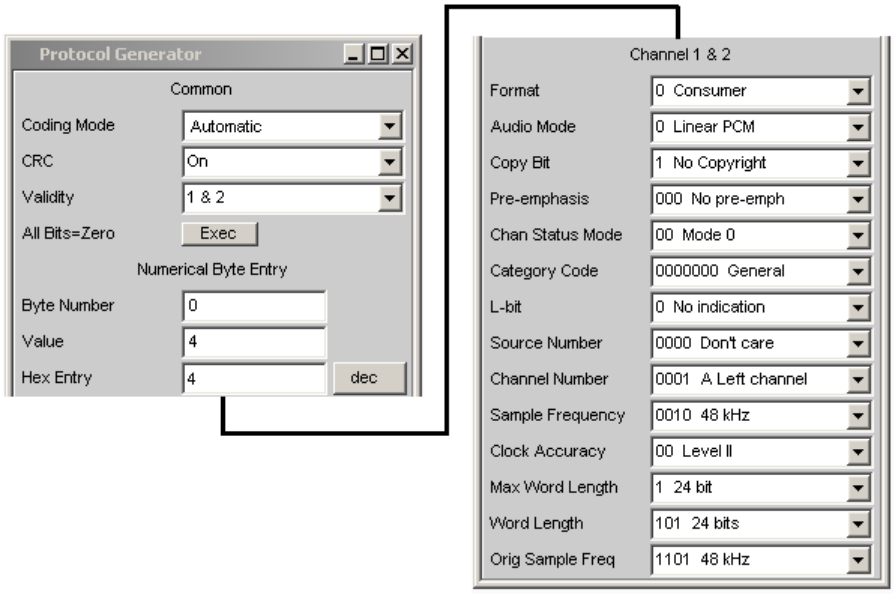
All setting options of the protocol generator are described here as they occur in conjunction with the "Digital Audio" generator instrument. **For the "HDMI" generator instrument, the setting options are limited to the Consumer mode.**

5.8.1 Higher-Level Settings

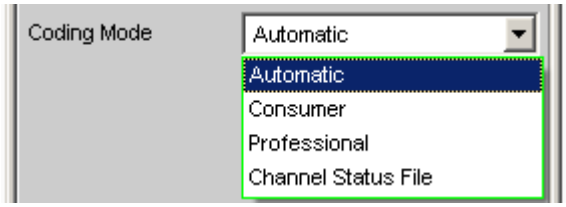
The control panel for the digital audio protocol generator is opened via the menu bar



or in the Generator Config panel of the "Digital Audio" generator instrument with the Protocol Generator Show button and in the Generator Config panel of the "HDMI" generator instrument with the Stream Header Show button



Coding Mode



This is for setting the input dialog for channel status data to Consumer or Professional.

"Automatic" The dialog is set depending on Bit 0 in Byte 0.
Bit 0 = 0 → Consumer
Bit 0 = 1 → Professional

"Consumer" Entry mask for the Consumer mode.

"Professional" Entry mask for the Professional mode.

"Channel Status File" The channel status bytes are read from a text file, set in the hardware and back-translated into the corresponding entry masks. User entries are not possible. To change settings, the loaded file must be edited.

Remote command:
SOURce:PROTocol:MODE on page 686

Channel Status File

File name for the channel status file from the channel status bytes to be set are read. Examples can be found in the BIN directory as `ChannelStatusCons.txt` and `ChannelStatusProf.txt`.

Remote command:
SOURce:PROTocol:FILE on page 686

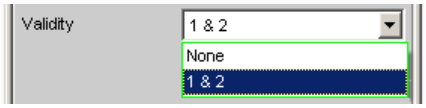
CRC

Cyclic Redundancy Check Character: A checksum is generated from the content of bytes 0 to 22 of the channel status data and transferred to byte 23. (Professional mode only).

The checkbox enables or disables the function.

Remote command:
SOURce:PROTocol:CRC on page 686

Validity



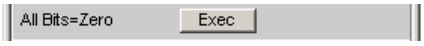
Defines the state of the validity bit.

"1 & 2" The validity bit is set.

"None" The validity bit is not set.

Remote command:
SOURce:PROTocol:VALidity on page 686

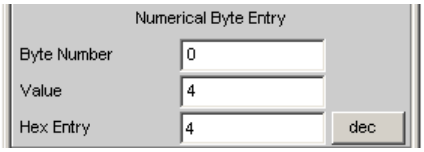
All Bits = Zero



This sets all bits to zero once only. Exception: Bit 0 in byte 0, which defines the coding mode as Consumer or Professional, is not changed.

Remote command:
SOURce:PROTocol:AZERo on page 685

5.8.2 Setting Bytes as Numerical Values



A byte can be set to any value in this entry block. It is even possible to set bit combinations that are not yet defined in the standard.

Byte Number
Selects the byte, 0 to 4.

Remote command:
`SOURce:PROTocol:NUMerical:BYTE` on page 686
`SOURce:PROTocol:CH<n3>:BYTE<n4>` on page 685

Value
The decimal value for the byte selected is displayed here and can also be entered.

Remote command:
`SOURce:PROTocol:NUMerical:VALue` on page 686
`SOURce:PROTocol:CH<n3>:BYTE<n4>` on page 685

Hex Entry
The byte value can be displayed or entered in hexadecimal, binary or decimal.

If the entry brings about a bit combination that is not yet defined in the standard, the parameter has no meaning that can be displayed. In this event ********** is displayed.

5.8.3 Setting Bytes in Remote-Control Mode

When entering or querying values in remote control mode, an easier method than the two individual commands for byte and value

`SOURce:PROTocol:NUMerical:BYTE <y>`

`SOURce:PROTocol:NUMerical:VALue <n>`

is to use the following, combined remote-control command:

`SOURce:PROTocol:CH<x>:BYTE<y> <n>` for the input

`SOURce:PROTocol:CH<x>:BYTE<y>?` for a query

After the switchover back into Local mode, the settings which are configured via this remote-control command in the protocol generator panel are displayed in plain text in the corresponding parameter fields.

"Parameters:"

<x> → 1

<y> → 0 to 4

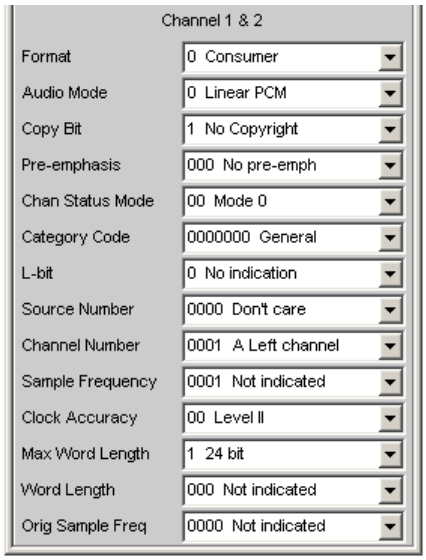
<n> → 0 to 255 (decimal)

5.8.4 Displaying and Setting Parameters in Plain Text

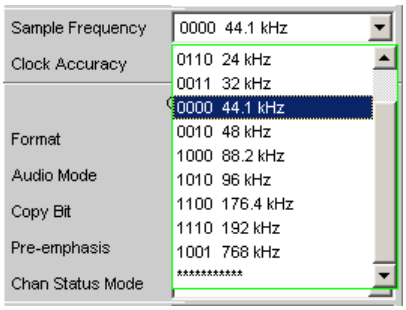
Parameters can be entered here as defined in the standard. This is possible only for manual operation, not in remote-control mode.

The bit combination and meaning are displayed.

The effect of an entry via Numerical Byte Entry is also displayed here.



Setting parameters
A selection is offered for each parameter as defined in the standard. This example is for the Sample Frequency in Consumer mode.



The line ********** indicates an undefined bit combination (which is possible when Numeric Byte Entry is used).

An attempt to set this line is refused with the following message:

. The hardware remains unchanged and the prior status is displayed.

5.9 Sweeps

With many generator functions, it is advisable to output the signal parameters (level and frequency) not only statically but also to vary them over time. Varying one or more of the signal parameters is referred to as a (generator) sweep. The measured values obtained can be, but do not have to be, recorded as series of measured values.

The R&S UPPhas a highly flexible sweep system for this purpose, in which up to two generator parameters or one analyzer parameter (variation of the center frequency of the RMS selective filter) can be varied in a wide variety of ways. When the generator sweep is switched on, any active analyzer sweep is switched off and vice versa.

The sweep results (measured value series) can be displayed graphically (as a 2-D curve display in a sweep window) or numerically (as a sweep list, see chapter 5.9.6, "List sweep", on page 281). With the graphical display, the 1st sweep parameter is usually plotted on the x-axis, the recorded measured value on the y-axis and the optional 2nd sweep parameter on the z-axis (not visible in the 2-D graph). A Z sweep is therefore equivalent to a sweep with two parameters (2-dimensional sweep).

However, the x-axis can also be determined by the measured frequency ("X-Source " = Frequency) or the measured level ("X-Source " = LevMon…).

Up to 8 measured values can be recorded for each sweep point (in 4 sweep windows each with 2 traces). To plot a specific measurement parameter, the following setting has to be made in (at least) one of the four sweep display panels:

- the X-Source must be set to Sweep or the desired measurement function,
- (at least) one trace must be set to the desired Y-measurement function.

You can also set **multiple** traces to **one** measurement function, for example, to be able to measure them using different marker and/or cursor settings.

The generator sweeps can be configured in many different ways and can be distinguished according to the following characteristics:

- According to the number of varied signal parameters in **1 or 2-dimensional sweeps** (known as Z-Sweeps).
- According to the stepping condition into **synchronous and time-triggered sweeps**.
- According to the sweep axis division into **linear, logarithmic and list-controlled sweeps**.
- According to the sweep direction into **upward and downward sweeps**.
- According to the physical basic unit of the Sweep parameter into **Frequency, level and phase sweeps**.

- According to the behavior when the full-scale value is reached into **single and continuous sweeps**.

Which sweep parameters are available for the individual generator functions depends on the characteristics of the respective signal. The following generally applies:

- A frequency sweep is not possible for multi-tone signals or noise signals.
- A phase sweep, i.e. the variation in phase shift between Channel 1 and 2, is only possible for stereo sine waves and should only be performed if both frequencies are the same.
- Z-Sweeps are possible if at least two 2 signal parameters of the configured generator function are sweep-capable.

Table 5-1: List of the sweepable function parameters depending on the selected function

Function	VOLTAGE	FREQUENCY	Phase
Sine	yes	yes	---
Stereo Sine	yes	yes	yes
Multi-sine	---	---	---
Sine Burst	yes	yes	---
Mod Dist	yes (total voltage)	yes (user frequency)	---
DFD	yes (total voltage)	yes Mode IEC268: Center frequency Mode IEC118: Upper frequency	---
Arbitrary	---	---	---
Random	---	---	---
DC	yes	---	---
Polarity	---	---	---
Play	---	---	---
Universal	Yes (higher-level sine wave)	Yes (higher-level sine wave)	---

5.9.1 Activating / Deactivating the Sweep System

The sweep system is enabled and disabled using "Sweep Ctrl ". This simultaneously defines how the sweep is to be stepped and how the sweep axis is to be defined. For generator sweeps, this parameter field is located in the generator functions, the analyzer sweep is available only for the measurement function "RMS Selective" and explained in greater detail there (see chapter 5.21.3, "RMS Measurement, Selective", on page 349).

The sweep system can be activated and configured separately in each generator function. If the function (or instrument) is changed, the sweep system is reconfigured, activated or deactivated implicitly.

The generator sweep is also disabled when activating the analyzer sweep and when selecting Time Chart as the start condition (see chapter 5.16, "Start Conditions", on page 328).

You can start a sweep cycle by clicking the Start button (for continuous sweeps) or the Single button (for single sweeps) in the toolbar or using CTRL F5 or CTRL F6 on the external keyboard.

Each new sweep point that the sweep system sets automatically triggers a new measurement. If the measured values generated during measurement are to be recorded and displayed (graphically or numerically), the desired measured values (e.g. "Funct Ch1") must be selected as "Traces" in the sweep display panels. Furthermore, it must also be ensured that the x-axis is set to "Auto" in the sweep display panels used during recording of measured values.

On completion of the sweep measurements, the used traces and the associated x-axes should be switched to "Hold" to prevent the sweep results from being deleted if instrument settings are changed inadvertently.

When the sweep system is enabled, START , SINGLE and STOP/CONT has the following effect:

- START starts a continuous sweep,
- SINGLE starts a single sweep or continues an already started continuous sweep as a single sweep.
- STOP/CONT stops an ongoing sweep or continues a stopped sweep.

Sweep Ctrl
Used to activate and configure or deactivate the generator sweep system.

"Off" The generator sweep system is deactivated; no additional parameter fields are displayed.

If the analyzer sweep system is likewise switched off, START , SINGLE and STOP/CONT has an effect on the measurement system:

- START starts a continuous measurement,
- SINGLE starts a single measurement or continues an already started continuous measurement as a single measurement.
- STOP/CONT interrupts an ongoing measurement or continues an interrupted or terminated measurement as a continuous measurement.

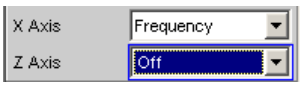
"Auto Sweep" The generator sweep system is activated; the sweep stepping is performed automatically; the sweep axis is calculated from the start value, stop value and step size or point number.
The stepping condition (fixed time grid or synchronized to the analyzer) is determined in the "Next Step" parameter field.

"Auto List" The generator sweep system is activated; the sweep stepping is performed automatically; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file).
The stepping condition (fixed time grid or synchronized to the analyzer) is determined in the "Next Step" parameter field.

Remote command:
`SOURce:SWEep:CONTrol` on page 688

5.9.2 One-Dimensional Sweep

With one-dimensional sweeps, only 1 parameter is varied; the z-axis is deactivated.



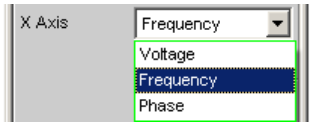
Each sweep cycle can consist of a maximum of 1024 individual points, which means that the x-axis is divided into a maximum of 1023 steps.

As soon as all of the points on the x-axis have been processed, the analyzer returns to the 1st X-value and performs the next sweep cycle using the same settings.

The last 20 sweep cycles (scans) are available as the data set. If more than 20 scans have been performed, only the last 20 can be saved as the trace data set. Similarly, only the last 20 scans are retained if the graph is rescaled.

A one-dimension continuous sweep started using START is repeated in an infinite loop.

X-axis
Used to select the sweep parameter (with one-dimensional sweeps) or the first sweep parameter (with two-dimensional sweeps). Only visible for activated generator sweep system.



The reason for designating the sweep axis as the "x-axis" is that this sweep parameter is normally entered as the x-axis in the 2-D graphic.

Note: It is also possible to plot a measured value on the x-axis (e.g. the measured RMS in the case of external measured value triggering). In such cases, the sweep axis (sweep x-axis) and the graphical x-axis are not necessarily identical.

"Voltage" Used to activate a level sweep. Which signal parameter is actually swept (e.g. the level of a single sine-wave line or the total level of a multi-tone signal) depends on the respective generator function.

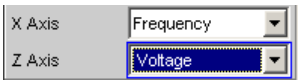
"Frequency" Used to activate a frequency sweep. Not possible for noise signals and multi-tone signals. Which signal parameter is actually swept (e.g. the frequency of a single sinusoidal line or the center frequency of a two-tone signal) depends on the respective generator function.

"Phase" Used to activate a phase sweep. Possible only for the generator function "Stereo Sine ".

Remote command:
`SOURce:SWEep:XAXis` on page 689

5.9.3 Two-Dimensional Sweep

For two-dimensional sweeps, 2 (different) parameters are varied; the first parameter is selected as the x-axis, the second parameter is selected as the z-axis.



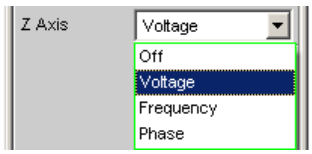
Both axes (sweep dimensions) can each consist of max. 1024 individual points, which means that each axis is divided into max. 1023 steps.

As soon as all of the points on the x-axis have been processed, the analyzer returns to the 1st X-value and simultaneously sets the next Z-value. When the sweep cycle for the last Z-point has been completed, the X and Z-values are reset to their original start values.

The last 20 sweep cycles (scans) are available as the data set. If the z-axis contains more than 20 points, only the last 20 scans can be stored as a trace data record. Similarly, only the last 20 scans are retained if the graph is rescaled.

A two-dimension continuous sweep started using START is terminated after the sweep cycle of the last Z-point.

Z-axis
Select the second sweep parameter for the two-dimensional sweep. Is simultaneously used to enable or disable the two-dimensional sweep. Only visible for activated generator sweep system.



Note: With the DC generator function, only one parameter can be swept. The ""z-axis"" parameter field (and therefore a two-dimensional sweep) is not available in this case.

Note: When switching on the Z-sweep, the Sweep Graph Config panel is switched over to Multi Scan, provided the "X-Source " of the respective window is set to Sweep. At the same time, the number of points on the z-axis (20 maximum) is copied to the Sweep Graph Config panel as "History" if it is larger than the value specified there.

"Off"	Used to deactivate the two-dimensional sweep (switch-over to a one-dimensional sweep).
"Voltage"	Used to activate the two-dimensional sweep and select the level variation as the second sweep parameter. Which signal parameter is actually swept (the level of a single sine-wave line or the total level of a multi-tone signal) depends on the respective generator function.
"Frequency"	Used to activate the two-dimensional sweep and select the frequency variation as the second sweep parameter. Not possible for noise signals and multi-tone signals. Which signal parameter is actually swept (the frequency of a single sine-wave line or the center frequency of a two-tone signal) depends on the respective generator function.
"Phase"	Used to activate a two-dimensional sweep and select phase variation as the second sweep parameter. Only possible for stereo signal.

Remote command:
`SOURce:SWEep:ZAXis` on page 690

5.9.4 Automatic Sweep

With automatic sweeps, the sweep stepping is performed automatically when a measurement has been completed (synchronous sweep) or when a definable dwell time has expired (time-triggered sweep, dwell sweep). After START , the sweep runs continuously without further user input (for one-dimensional continuous sweeps), for SINGLE sweeps until the last sweep point is reached.

Synchronous sweep ensures that sweep stepping is performed when the analyzer has carried out all the required measurements. At the same time it ensures the highest possible sweep speed, since the next sweep point is set as soon as measurements have finished.

Time-triggered sweep is only worthwhile in exceptional cases:

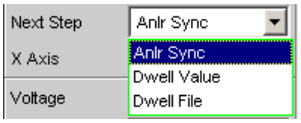
- When the analyzer is not in use.
- When the analyzer is actually being used, but the intention is for sweep stepping to be performed independently of measurement time. However, the chosen dwell time must be long enough for all measurements to have been completed before the dwell time expires.

If you want to also generate valid measured values during a time-triggered sweep, we recommend selecting the settings in the analyzer to eliminate the possibility of unexpectedly prolonging the measuring period (e.g. by disabling Settling, disabling the autoranger in the analog analyzer, selecting a fixed measuring time).

The automatic sweeps are selected in the "Sweep Ctrl" parameter field, whereby the sweep axis

- is calculated from user entries ("Auto Sweep") or
- is loaded with a predefined list (e.g. from a file) ("Auto List")

Next Step
Used to select the sweep stepping. Only visible for automatic sweeps.



"Anlr Sync" The sweep stepping is synchronized to the analyzer, i.e. a new sweep point is set automatically when all measurements activated in the analyzer have been completed. This setting should be selected whenever the internal analyzer is used for sweeping. It ensures that a measured value is determined for every sweep point with minimum sweep time.

Note: If one or more measured values cannot be determined for a sweep point (e.g. because the level range of the analyzer was selected too low or the signal supplies too high of a level), the affected measured values are marked as invalid (NAN) and the next sweep point is configured.

"Dwell Value" The sweep stepping is time-controlled in constant intervals, i.e. a new sweep point is set automatically if the preset time has expired, irrespective of whether the measurements activated in the analyzer have been completed. A new measurement is started at the same time. The user can enter the dwell time in the next parameter field.

This setting ensures that sweep stepping is carried out in a fixed time grid. It should only be chosen if the internal analyzer is not in use, measured values are not needed or the dwell time is longer than the longest measurement time.

Note: Especially for frequency sweeps, the required measuring time of the individual sweep points is very different. If it is intended to generate measured values, the "slowest" sweep point must be taken as a basis when defining the necessary dwell time (for frequency sweeps this is normally the lowest frequency). A higher sweep speed can be achieved by using "dwell files". If the selected dwell time is too short thus preventing one or more measured values from being determined, the measured values concerned are marked as invalid ("NAN").

"Dwell File" The sweep stepping is time-controlled in individually set intervals, i.e. a new sweep point is set automatically if the associated time has expired, irrespective of whether the measurements activated in the analyzer have been completed. A new measurement is started at the same time.
The file containing the list of dwell times can be specified by the user in the parameter field below.

This setting makes it possible to specify not only a separate dwell time for each sweep point, but also an individual measurement time. It should only be chosen if the internal analyzer is not in use, measured values are not needed or the dwell time of a sweep point is longer than the associated measurement time.
The dwell list is processed in the direction of the sweep, i.e. starting with the last entry in the case of a downward sweep. The specified dwell time will thus be maintained for each sweep point even if the sweep direction is changed.

Note: If measured values are also required in this mode, the individual measuring time should be determined and entered to attain a high sweep speed. This applies particularly to frequency sweeps using automatic measurement time. If the dwell-time list is shorter than the sweep list or the length of the sweep axis, the last dwell time in the list is applicable for all remaining sweep points.

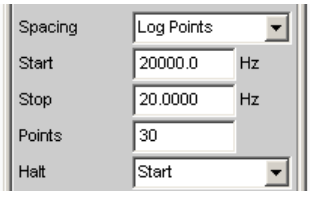
Remote command:
`SOURce:SWEep:NEXTstep` on page 688
`SOURce:SWEep:DWELl` on page 688
`MMEMory:LOAD:DWELl` on page 687

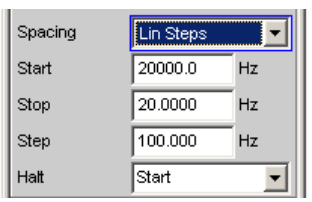
5.9.5 Linear and Logarithmic Sweep

Both linear and logarithmic sweeps are calculated automatically from user entries.

For this purpose, the user must specify:

- the spacing type (logarithmic or linear)
- either the number of points ("Points") or the step size ("Step")



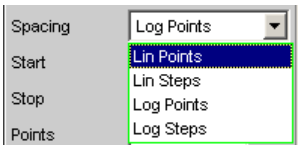


- the start and stop value ("Start" and "Stop"), which implies the sweep direction
  If no logarithmic spacing was selected, the DC generator function for "Start", "Stop" and "Halt" can be assigned a **negative level**.

The start and stop value mark the region of interest of the x-axis and thus are used as the x-axis scaling in the sweep graphs if the "Scaling " of the x-axis is set to Auto.

A maximum of 1024 points are available for each sweep axis which means that each axis can be divided into max. 1023 (linear or logarithmic) equidistant steps.

Spacing
Used to select the sweep range spacing, i.e. the way in which the sweep points are distributed on the sweep axes. Only visible for activated generator sweep system. It is set separately for each sweep parameter.



Can be selected separately for each sweep parameter (i.e. x and z-axis).

"Lin Points" The sweep range is divided linearly by specifying a number of points (linear sweep). This number is entered in the "Points" parameter field. Should be selected if equidistant, linear spacing of all points is required.

"Lin Steps" The sweep range is divided into intervals of a specified linear step size starting at "Start" (linear sweep). This step size is entered in the "Step" parameter field.

"Log Points" The sweep range is divided logarithmically by specifying a number of points (logarithmic sweep). This number is entered in the "Points" parameter field. Not possible for phase sweep.
Should be selected if equidistant, logarithmic spacing of all points is required.

"Log Steps" The sweep range is divided into intervals of a specified logarithmic step size starting at "Start" (logarithmic sweep). Each sweep point is calculated by multiplying the previous point by a constant factor. This factor is entered in the "Step" parameter field. Not possible for phase sweep.

Remote command:
`SOURce:SWEep:FREQuency:SPACing` on page 689
`SOURce:SWEep:PHASe:SPACing` on page 689
`SOURce:SWEep:VOLTage:SPACing` on page 689

Start
Used to enter the start value for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system. It is set separately for each sweep parameter.

The start and stop value implicitly determine the sweep direction:

If the start value is less than the stop value, an upward sweep is performed, otherwise a downward sweep will be performed.

If a start value identical to the stop value is entered, the stop value is automatically loaded with the old start value. In this way, it is possible to change the sweep direction by entering just one value.

Remote command:

`SOURce:SWEep:FREQuency:STARt` on page 689

`SOURce:SWEep:PHASe:STARt` on page 689

`SOURce:SWEep:VOLTage:STARt` on page 689

Stop

Used to enter the stop value for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system. It is set separately for each sweep parameter.

The start and stop value implicitly determine the sweep direction:

If a stop value identical to the start value is entered, the start value is automatically loaded with the old stop value.

Remote command:

`SOURce:SWEep:FREQuency:STOP` on page 689

`SOURce:SWEep:PHASe:STOP` on page 689

`SOURce:SWEep:VOLTage:STOP` on page 689

Points

Used to enter the number of sweep points for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system if "Lin Points" or "Log Points" is set for "Spacing". It is set separately for each sweep parameter.

The sweep range is divided into "Points – 1" (linear or logarithmic) equidistant steps. At least 2 points (start and stop value) are required.

A maximum of 1024 points can be selected for each sweep parameter.

Note: If the z-axis contains more than 20 points, only the last 20 scans are available as the data set (for saving and rescaling the graph). If you want to store a two-dimensional sweep as a complete trace data record, the number of points of the z-axis must not exceed 20.

Note: The number of points on the z-axis (20 maximum) is copied to the Sweep Graph Config panel as "History" if it is larger than the value specified there and the X-Source of the respective window is set to Sweep.

Remote command:

`SOURce:SWEep:FREQuency:POINts` on page 689

`SOURce:SWEep:PHASe:POINts` on page 689

`SOURce:SWEep:VOLTage:POINts` on page 689

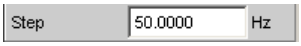
Step

Used to enter the (linear or logarithmic) step size for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system if "Lin Steps" or "Log Steps" is set for "Spacing". It is set separately for each sweep parameter.

The entry range is limited automatically so that at least one and at most 1023 single steps exist (corresponding to 1024 sweep points).

With linear step, the size of the step must always be entered, i.e. the numeric value is positive even if the start value is greater than the stop value. The physical unit is the same as that used when specifying "Start" and "Stop".

(Example for lin. frequency sweep)



With logarithmic step, the factor must be entered by which each sweep point is to be multiplied in order to move to the next sweep point. The logarithmic step size of level sweeps can also be specified in dB. Swapping the start and stop value (reversal of the sweep direction), therefore produces the reciprocal value and changes the sign of the dB value. The closer the numeric value is to 1.0 or 0 dB, the more sweep steps are carried out.

(Example for log. upward sweep)

Note: Since the last step of the sweep is automatically adapted such that it corresponds exactly to the stop value, it may deviate by max. 50 % from the selected step size. If this is to be avoided, either the start/stop value must be corrected accordingly or the sweep spacing must be set using the "Points" parameter.

Note: The number of points on the z-axis (20 maximum) – determined by Start, Stop and Step – is copied to the Sweep Graph Config panel as "History" if it is larger than the value specified there and the X-Source of the respective window is set to Sweep.

Remote command:

`SOURce:SWEep:FREQuency:STEP` on page 689

`SOURce:SWEep:PHASe:STEP` on page 689

`SOURce:SWEep:VOLTage:STEP` on page 689

5.9.6 List sweep

With list-controlled sweeps, any sweep axis can be defined. The sweep points may be any distance apart, but must be in ascending or descending order ("Random sweep"). The sweep points are processed by the sweep system in the order in which they are

listed. To define the list sweep as an upward or downward sweep, the sweep points must be entered in the appropriate order. Whereas in a normal sweep each sweep point is measured once only within a scan, the list sweep also offers the ability to measure individual sweep points a multiple number of times. This is achieved by entering the relevant sweep point in the list an appropriate number of times.

The list is usually loaded as a file. It must contain at least two (different) points. For the format of the list, refer to chapter 5.49.3, "Sweep Lists", on page 579.

A maximum of 1024 points are available for each sweep axis; if the list contains more than 1024 values, only the first 1024 points are loaded. The first and last points in the list define the sweep direction. If the list contains a point which does not comply with this direction, the point and all subsequent points are ignored.

The first and last (valid) point of the sweep list mark the region of interest of the x-axis and thus are used as the x-axis scaling in the sweep graphs if the scaling of the x-axis is set to Auto.

When the sweep list is being loaded, a check is made to see whether the actual basic measurement unit of the sweep file matches the sweep parameter. In addition to the R&S UPP list format (preferably with the extension *.SWL), files are also accepted that originate from the predecessor instruments, R&S UPL and R&S UPD.

If the z-axis of the two-dimensional sweep is defined as a list containing more than 20 points, only the last 20 scans are available as the data set (for saving and rescaling the graph). If you want to store a two-dimensional sweep as a complete trace data record, the number of points of the z-axis must not exceed 20.

Tot Volt File, Volt File
Used to enter the file name for the list of the level sweep parameter (level sweep list). Only visible with generator list sweep activated.

Which signal parameter is actually swept (the level of a single sine-wave line or the total level of a multi-tone signal) depends on the selected generator function.

Remote command:
`MMEMory:LOAD:VOLTage` on page 688

Freq File, Upp Freq File, Mean Freq File
Used to enter the file name for the list of the frequency sweep parameter (frequency sweep list). Only visible with generator list sweep activated.

Which signal parameter is actually swept (the frequency of a single sine-wave line or the center frequency of a two-tone signal) depends on the selected generator function.

Remote command:
`MMEMory:LOAD:FREQuency` on page 688

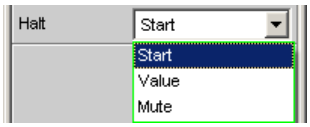
Phase File
Entry of file name for the phase sweep list. Only visible with generator list sweep activated. Reference

Remote command:
`MMEMory:LOAD:PHASe` on page 688

5.9.7 Behavior after Sweep End

The behavior after sweep end determines which signal the generator outputs after a completed sweep or if the generator is muted.

Halt



After a completed sweep, the generator outputs a signal to be determined by the user or is muted.

"Start" After a completed sweep, the generator is set as follows:
- For "Sweep Ctrl" = "Auto Sweep": As specified in the "Start" parameter field above this.
- For "Sweep Ctrl" = "Auto List": As specified in the first entry of the sweep list.

"Value " After a completed sweep, the generator is set to the value specified in the following parameter field. This value can be **outside** of the values defined by "Start" and "Stop" or outside of the first and last entries of the sweep list.

"Mute" **After a completed sweep**, the generator level is set to 0 V or 0 FS. The next sweep cycle eliminates the mute and begins again with the "Start "value or the first entry of the sweep list.
With running sweep, the generator is immediately muted, the sweep is restarted, and the generator is implicitly switched on again.

Remote command:
`SOURce:SWEep:FREQuency:HALT` on page 688
`SOURce:SWEep:PHASe:HALT` on page 688
`SOURce:SWEep:VOLTage:HALT` on page 688

Halt value

If the parameter field above it is set to "Halt " = "Value " after a completed sweep, the generator is set to the value specified here. This value can be **outside** of the values defined by "Start" and "Stop" or outside the first and last entries of the sweep list.

Remote command:

`SOURce:SWEep:FREQuency:HALT:VALue` on page 688

`SOURce:SWEep:PHASe:HALT:VALue` on page 688

`SOURce:SWEep:VOLTage:HALT:VALue` on page 688

5.9.8 Sweep Speed

The time required for a sweep cycle is only relevant for automatic sweeps and is determined by the following factors:

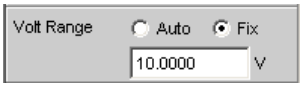
- Setting time of the generator
- Required dwell time; depends on the characteristics of the DUT (e.g. settling time)
- Only with synchronous sweeps (i.e. when using the internal analyzer): Measurement speed

The setting times of the generator and, if necessary, the measurement time should be minimized in order to ensure the shortest possible cycle time and thus a high sweep speed. A series of optimization options are provided for this purpose:

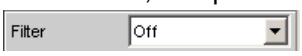
Minimizing the generator setting time

The setting time of the digital generator part is just a few microseconds and can therefore be disregarded. However, configuration of the analog software in the analog generator (which involves settling procedures) requires a number of milliseconds and should therefore be avoided for sweeps wherever possible.

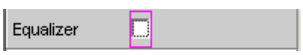
- Use of a **fixed level range** for level sweeps and active precorrection; the level should be set to the highest value that occurs during the sweep. The automatic operating mode controls the level of the analog hardware to maximize the signal-to-noise value of the generator at every level. This mode should only be used if sweeping is to be performed over several decades and both the DUT and the measurement function require a high S/N value.



- **Turning the filter off**. Whenever the frequency or level is changed, if a filter is switched on, it requires a settling time – even if it is only a short one.



- **Turning off the frequency equalizer** for frequency sweeps. If the equalizer is activated, a new level must be set for each new frequency. An alternative method of frequency response correction is to use suitable reference curves when recording the measured values.



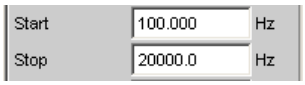
- **Reducing the dwell time** when using an external analyzer. The dwell time required by the DUT and the external analyzer must be determined by trial and

error and can be specified as a fixed value or separately for each sweep point as a list.

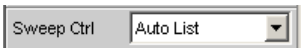
- **Synchronization** of the generator to the analyzer when using an internal analyzer. If the generator and analyzer of the R&S UPP are operated together, a generator sweep should always be synchronized to the analyzer. This ensures that the generator is advanced precisely at the point when all measurement results are available and have settled (where applicable also frequency, level monitor and input measurements on the active channels).

- Reducing the measurement points for **low frequencies**. Low frequencies require longer measuring times than higher frequencies. The sweep axis should therefore be divided in such a way that only a few low tones are used. This can be achieved in the following ways:
  Linear instead of logarithmic spacing

  Increasing the lower sweep limit



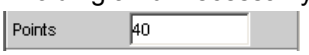
  List sweep



- Reducing the measurement points. The duration of the sweep cycle increases more or less linearly with the number of sweep points. The list sweep enables you to set the distances between the individual sweep points and thus to carry out a burst at locations of particular interest without increasing the total number drastically.
  List sweep

  Avoiding an unnecessarily small step size

  Avoiding an unnecessarily large number of sweep points



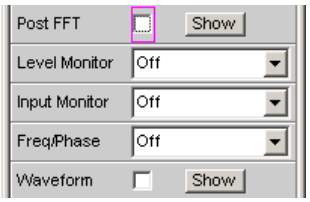
Minimizing the measurement time

When using the internal analyzer, the required measurement time depends on the selected measurement functions. Generally speaking, every measurement function used should wherever possible be configured for high measurement speed; this, of

course, depends on the specific measurement function. For this reason, only a few generally applicable rules are given below:

- Only activate those measurement channels which are to be measured. An unconnected measurement input can increase the measurement time considerably because measurement is only completed when a measured value exists for this channel. A number of measurement functions require considerably more time to measure a signal with a low level (noise). Even if there is a signal on the other channels, the measurement time will still be at least slightly longer than for single-channel mode, since the other channels must be fully evaluated and displayed.

- Only activate those measurement functions which are required for the specific measurement task.



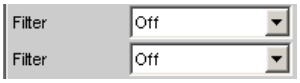
- Deactivate any traces that are not required. In 4 sweep windows, 2 traces can be activated in each window. Only those traces that are required for measured value recording should be active.

- If the internal generator is used, many measurement functions allow reference to its settings ("Gen Track"). These functions should be used since they not only shorten the measurement time (because, for example, the frequency does not have to be measured) but can also increase the measurement accuracy (e.g. sample-precise setup and measurement over entire periods without errors due to measurement termination in the case of RMS).
(With RMS and RMS Selective)

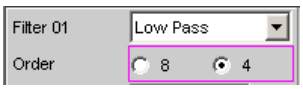
(With THD+N and THD)

(With RMS Selective)

- Deactivating unnecessary filters. The filters must resettle whenever generator settings are changed. Measurement is not possible during this time. The start of measurement is delayed by the sum of settling times for all activated filters.



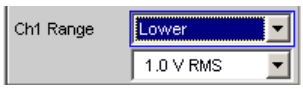
- Reducing the order and/or attenuation with user-defined highpass and lowpass filters. This reduces the settling time.



- Deactivating the settling functions. The settling function does not need to be activated for the majority of measurement signals. If a stable signal is present at the DUT, the R&S UPP delivers measured values in settled state even without Settling. The settling (or averaging) increases the measuring time by a factor of at least the number of configured samples.

- Deactivating the measurement start delay. The measurement start delay is intended to compensate delays of the DUT. Whenever generator or analyzer settings are changed, the start of the 1st measurement (and consequently every single sweep point) is delayed by the specified time. This time should be set to 0.0 if no start delay is necessary.

- Manual selection of the analyzer level range (only with analog measurement signals). If the level of the measurement signal is known and a limitation of the dynamic range is acceptable, the analyzer level range should be selected manually. It should be set to the highest anticipated level; an "UNDERRANGE" must be expected and tolerated in this case; a new measurement with corrected range setting is not performed. "Range LOWEST" can be selected to make sure that a higher level which would invalidate the measurement does not occur. This mode allows the measurement to correct the measuring range in case of OVERRANGE.



5.10 Selecting the Analyzer

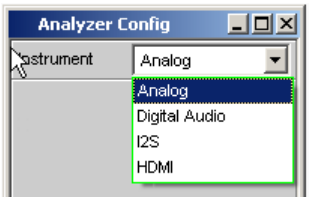
5.10.1 Analyzer Configuration Panel

The Config panel is used to set up the analog and digital analyzer.

To adapt the R&S UPP analyzer to the measurement task at hand, first define the settings in the Analyzer Config panel. These settings will influence which capabilities are available in the Analyzer Function panel.

The first step is to select one of the two analyzers (analog or digital).

Instrument
Used to selection the analyzer.



"Analog" Up to 8 channels with different bandwidths can be synchronously measured, see chapter 5.11, "Configure Analog Analyzer", on page 289.

"Digital Audio" Audio data can be measured, see chapter 5.12, "Configuring the Digital Analyzer", on page 298.

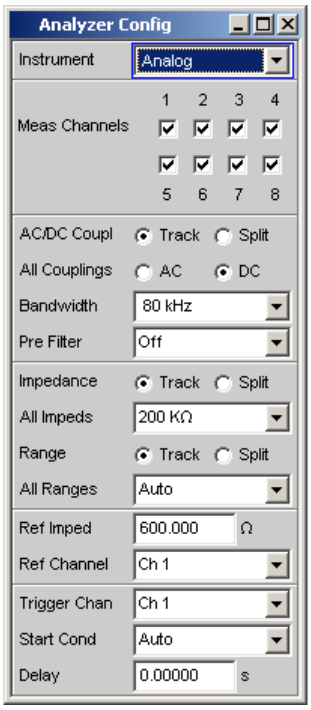
"I²S Board" The I²S Audio Analyzer can measure audio data (8 bit to 32 bit) in I²S format, see chapter 5.13, "Configuring the I²S Analyzer", on page 302.

"HDMI" The HDMI analyzer can be used to measure audio and video data, which are specified in accordance with the HDMI Standard 1.4a, see chapter 5.14, "Configuring the HDMI Analyzer", on page 311

Remote command:
`INSTrument<n1>` on page 690

5.11 Configure Analog Analyzer

5.11.1 Analyzer Configuration Panel



The Config panel allows you to make settings for the analog analyzers and the digital analyzer. The options for configuration of the analog Analyzer are described below. When Analyzer is called for the first time, all channels are activated and all ranges are set to Autorange to prevent overranging when any input signal is applied. For safety reasons the inactive channels are set to the most sensitive measurement range (50 V).

CAUTION

Danger of electric shock

The instrument complies with measuring category I; make sure that the input voltage at the connectors of the analog analyzers does not exceed 50 V (effective, sinusoidal) and 70 V (peak value).

Do not use the instrument in measuring categories II, III and IV.

Explanation:

Measuring circuits as defined in section 6.7.4 of EN61010-1:

Measuring category I is intended for measurements on circuits which are not connected to the high-voltage current system.

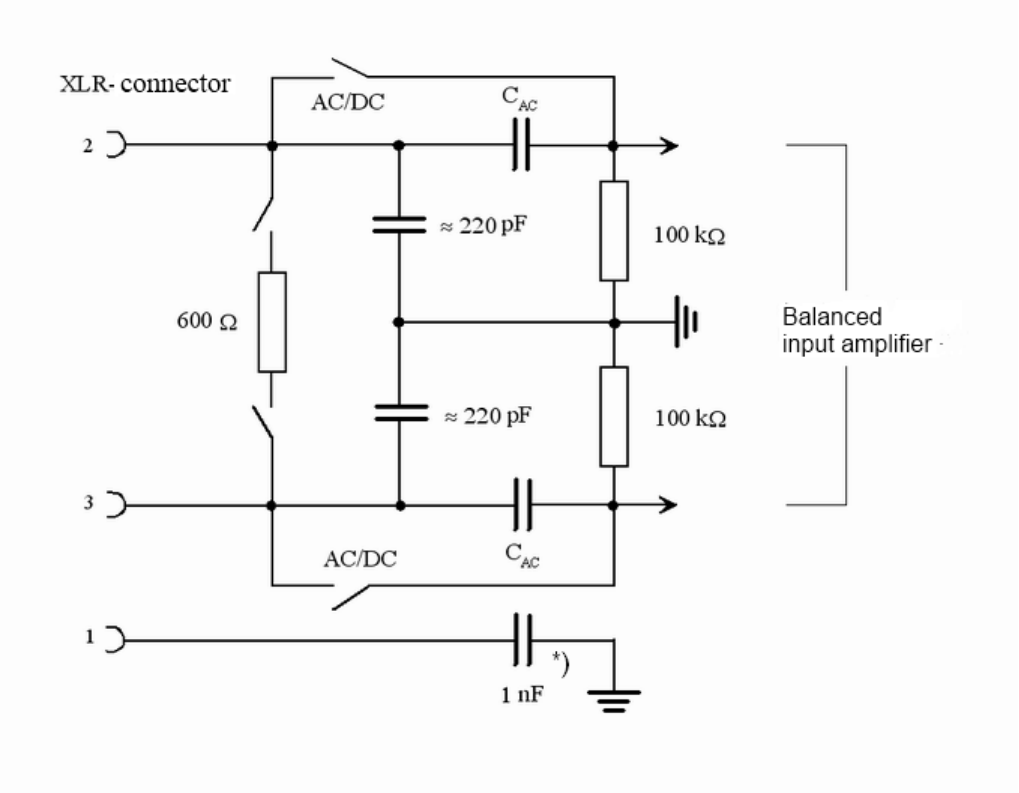


Fig. 5-5: Balanced analyzer input

*): Pin 1 is connected directly to the ground on instruments with serial numbers below 120100, 140100 and 180100!

The eight analyzer inputs are provided on the front panel of the R&S UPP in the form of XLR input sockets.

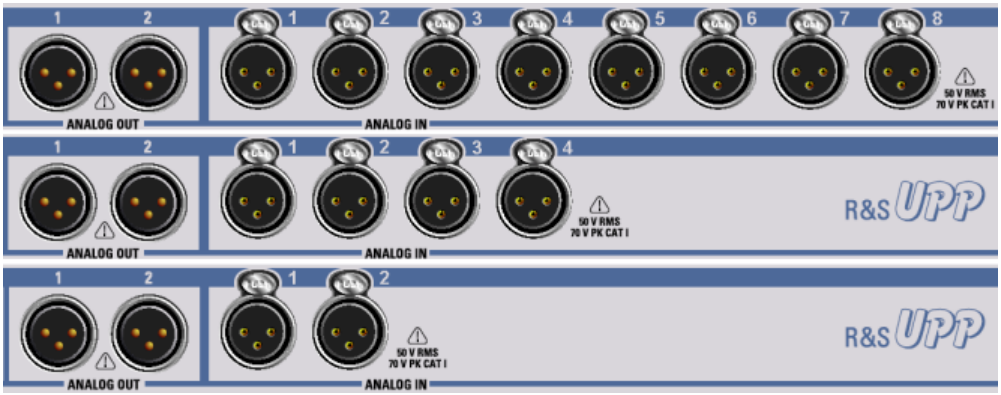


Fig. 5-6: UPP variants from top to bottom: R&S UPP800, R&S UPP400, R&S UPP200

If the signal is to be supplied via unbalanced analyzer inputs, it is advisable to use the R&S UP-Z1M or R&S UP-Z1MF XLR/BNC adapter. The internal connection of this adapter is shown in the illustration below.

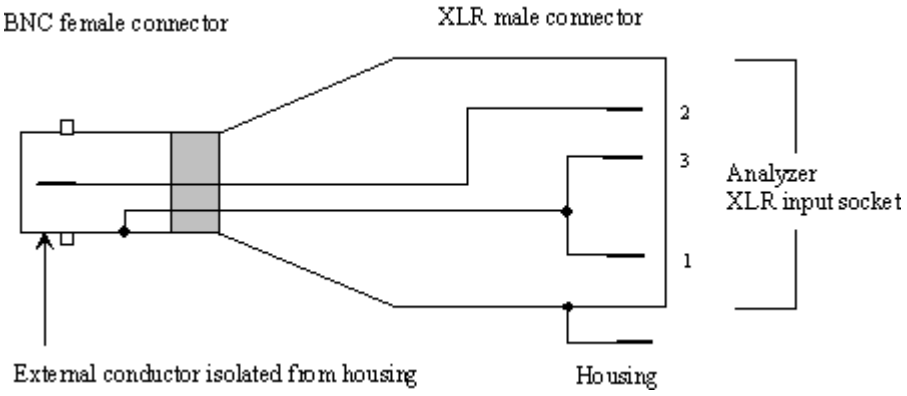


Fig. 5-7: R&S UP-Z1M XLR/BNC adapter

Meas Channels
Selecting active inputs.

The active measurement channels are selected by enabling the desired channels. All of the channels have differential inputs. **Switched off channels always have an input impedance of 200 kΩ and are always in the least sensitive range (50 V).**

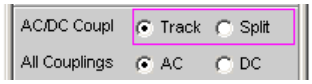
Remote command:
`INPut<n1>:MCHannels<n2>` on page 692

AC/DC Coupling
Used to select the input coupling.

AC or DC coupling can be selected. The coupling can be selected for all channels together (Track) or separately from each other (Split).

"Track mode"

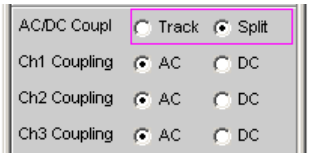
If Track is selected in the top line, you see the following line:



The reference channel for the Track function is always the reference channel. The coupling of the inactive channels does not change.

"Split mode: "

If Split is set, coupling can be selected for each channel individually:



Remote command:
INPut<n1>:COUPling:CHANnels on page 691

Chx Coupling
Used to select the input coupling.

AC or DC coupling can be selected. The selection of the coupling can be performed with the "AC/DC Coupling" program field above it jointly for all channels (Track) or separate of each other (Split).

DC coupling should be selected if input voltages with very low-frequency signal components are to be measured.

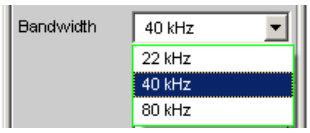
"AC" The DC component of the measurement signal is removed at the input using a highpass filter and therefore cannot affect the measurement result.

"DC" Measurement signals up to 0 Hz are recorded and taken into consideration in the measurement results of RMS, RMS Selective, Peak, DC, FFT and Waveform.

Note: If the input signal contains a large DC component, this results in a reduced dynamic range for the AC component, since the measurement range of the input amplifier is based on the overall signal.

Remote command:
INPut<n1>:COUPling on page 691

Bandwidth
3 different analyzer bandwidths are available; the selected bandwidth determines the upper frequency limit for the measurement signal.



"22 kHz" The maximum signal frequency is 22 kHz. The signal is sampled at 48 kHz.

"40 kHz" The maximum signal frequency is 40 kHz. The signal is sampled at 96 kHz.

"80 kHz" The maximum signal frequency is 80 kHz. The signal is sampled at 192 kHz.

Remote command:
INPut<n1>:BANDwidth:MODE on page 691

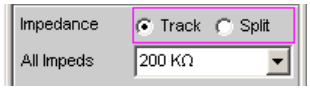
Pre Filter
The selected prefilter affects all measurement functions. This permits desired prefiltering without selecting appropriate filters for the individual measuring functions.

For the characteristics of the various filters, see chapter 5.36, "Filter", on page 444.

Remote command:
INPut<n1>:FILTer on page 737
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

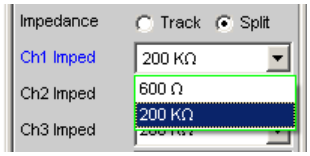
Impedance
Starting with serial numbers 120100, 140100, 180100, the input impedance can be switched between 200 kΩ and 600 Ω, previously 200 kΩ were permanently set.

The setting for input impedance can be selected for all 8 channels together (Track) or separately for each channel (Split).



Remote command:
INPut:MIMPedance:CHANnels on page 692

Chx Imped
Channel-specific setting of the input impedance.



The "Split" setting provides the two impedances 600 Ω or 200 kΩ for each of the 8 channels. Minor restrictions for the Chx Range settings (see next page) protect the 600 Ω input impedances against overload.

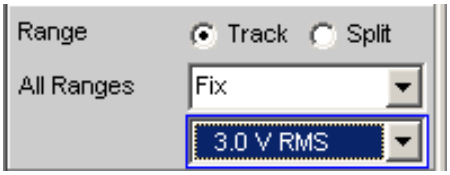
The "Track" setting provides one impedance setting for all channels.

Remote command:
INPut:MIMPedance<n2> on page 692

Range
Selecting an appropriate measurement range enables settings to be optimized for the voltage range depending on the measuring task.

As with the switch-over between AC and DC coupling, it is also possible to select between two options for range setting: either a common setting function for all ranges of the active channels or independent setting of individual channels.

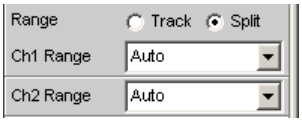
The reference channel for the Track function is always the active channel. Independent of this, the inactive channels always remain in the most insensitive range.



To prevent overranging of one or more active channels, the least sensitive range of all active channels is set by the following manual switch-overs:

- In Track mode when switching over from Auto to Lowest, or from Fix to Lowest
- When switching over from Split to Track if the reference channel is set to Fix or Lowest.

If Split was selected in the top line, the range settings can be selected separately for each activated channel above.



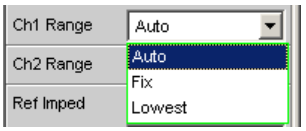
The number of newly displayed lines depends on the number of activated measurement channels.

Remote command:
`INPut<n1>:RANGe:CHANnels` on page 692

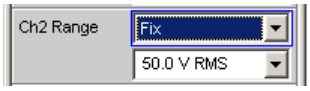
Chx Range
Selecting an appropriate measurement range enables settings to be optimized for the voltage range depending on the measuring task.

As with the switch-over between AC and DC coupling, it is also possible to select between two options for range setting: either a common setting function for all ranges of the active channels or independent setting of individual channels, see "Range" on page 293.

It is possible to switch between 3 modes. If all channels have the same setting (Track), only the text "All Ranges" appears to the left of the selection box.



If the Fix or Lowest mode is selected, the set nominal range value appears in the next line, where a new range can be set by opening the selection window.



The ranges are graduated in steps of 12 dB from 200 mV to 50 V and allow very good dynamic response when measuring nonlinear distortion. If "Range Auto" (automatic range selection) is set, overranging or underranging of the limits in a current measuring range causes the instrument to switch to the next step. This is also the case for the "Range Lowest" range setting; here, however, the instrument only goes down to the selected range limit.

The range values are RMS values for sine waves or other signal shapes up to a crest factor of √2.

ch = Channel number 1 … 8

nu = "range nominal value or "any voltage value""

nu = 200 mV	(0.00 to 0.21999 V)
nu = 800 mV	(0.22 to 0.87999 V)
nu = 3 V	(0.88 to 3.29999 V)
nu = 12 V	(3.3 to 13.19999 V)
nu = 50 V	(13.2 to 55.00 V)

"Auto" Automatic measurement range selection. The optimum range is set separately for each channel.
If an input impedance of 600 Ω was selected, and the auto ranger detects a level of more than 12 V in **any channel**, then the input impedance is switched for **all channels** to 200 kΩ and the 50 V range is activated to protect the input impedances against overload!

"Fix" The set measurement range is fixed.
If an input impedance of 600 Ω was selected, 140100, 180100, **"Fix" is not being offered** to protect the input impedances from overload!

Note: If a voltage exceeding the selected level range is applied, the analyzer status is displayed with a red digit in the lower status line (the digit indicates the channel that is overranged) and the measured values are shown as invalid ("---"). On switching from Auto to Fix, the currently valid range in the channel is taken over.

"Lowest" The set measuring range is fixed as the lowest range; in the event of overdrive, this range is automatically substituted by higher ranges.
If an input impedance of 600 Ω was selected, the **50 V measuring range is not being offered**. If the auto ranger detects a level of more than 12 V in any channel, then the input impedance is switched to 200 kΩ for all channels and the 50 V range is activated to protect the input impedances from overload

Note: On switching from Auto to Lowest, the currently valid range in the channel is taken over.

Remote command:
`SENSe<n1>:VOLTage:RANGe<n3>:MODE` on page 693
`SENSe:VOLTage:RANGe<n3>:VALue` on page 693

Ref Imped
Reference value for impedance.

Reference impedance for the indicated power in the units dBm, W, (Δ%W, ΔW, P/Pr and %P/Pr.

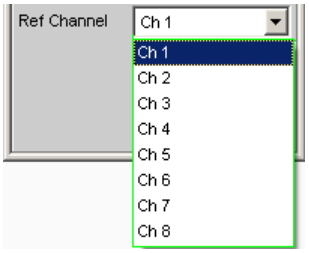
The power is calculated using the following formula:

$$P = \frac{U^2}{R}$$

where U is the measured voltage and R is the set reference impedance. The indicated power is only correct if the reference impedance is identical to the resistance of the DUT.

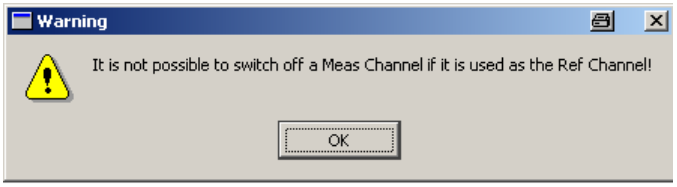
Remote command:
SENSe<n1>:POWer:REFerence:RESistance on page 693

Ref Channel
Reference channel for phase measurements, channel-specific measurements such as common-channel selectivity and the like.



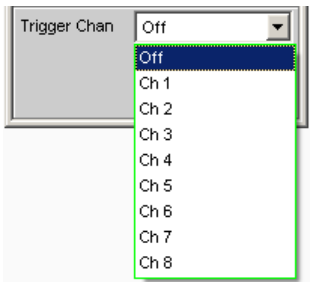
Each measuring channel can be selected as a reference channel. If a channel which is selected as a reference channel is not yet active (switched off), the channel is automatically switched on.

Switching off a measuring channel that was selected as the reference channel is prevented, and the user is advised of this by the following warning:



Remote command:
SENSe<n1>:REFerence<n2>:CHANnel on page 703

Trigger Chan
Used to select the channel whose event triggers a measurement.

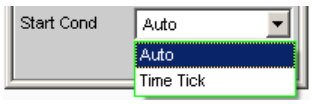


If a measuring channel which was inactive is selected as a trigger channel it is automatically switched on. A warning appears if the channel selected as a trigger channel is switched off.

Switching off the measuring channel, which was selected as the trigger channel, therefore changes the trigger channel after this warning has been acknowledged.

Remote command:
TRIGger:CHANnel on page 703

Start Cond
Specifies the event which triggers a measurement.



Depending on the "Start Cond" selected, the measurement either begins immediately (Auto) or only when the desired trigger condition is fulfilled; for details see chapter 5.16, "Start Conditions", on page 328.

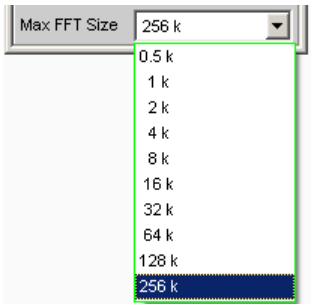
Remote command:
TRIGger:SOURce on page 704

Delay
Delay for Start Cond.

A delay time can be entered for the "Start Cond Auto" menu item; for details see chapter 5.16, "Start Conditions", on page 328.

Remote command:
TRIGger:DELay on page 703

Max FFT Size
Used to limit automatic zoom fitting for the FFT size for all FFT-supported measurement functions (e.g. THD, THD+N, DFD, each with Post FFT) to the selected value with the goal of increasing measurement speed.

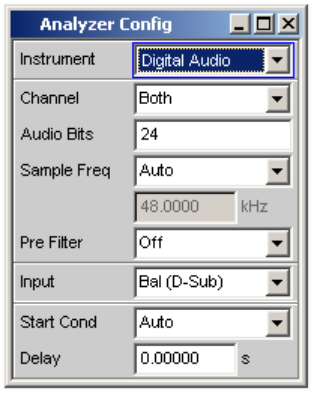


The limit to the FFT size is particularly useful for external sweeps for adapting the measuring time to the time frame of an external time tick. A limit is usually associated with degradation in measuring accuracy since incidents such as carrier-level noise can no longer be completely recorded.

Remote command:
SENSe<n1>:MAX:FFT:SIZE on page 692

5.12 Configuring the Digital Analyzer

5.12.1 Digital Analyzer Configuration Panel



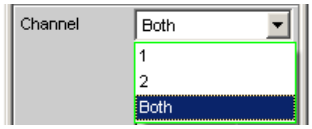
The Config panel is used to set up the analog and digital analyzer. The configuration options for the digital audio analyzer are described below. The digital Audio Analyzer is only available with the R&S UPP B2 (digital audio interfaces) option or R&S UPP B4 (HDMI and digital audio interfaces) option.

With digital audio interfaces, there are basically two signal types, i.e. the physical interface signal and the encoded audio signal itself.

The R&S UPP measures the encoded audio signal. The data content of the selected digital audio input is extracted from the digital audio signal and analyzed. The measurement of the physical interface signal is only performed by the R&S UPV Audio Analyzer.

Channel
Used to set the active measurement channel.

Used to select the audio data for the left channel (Channel = 1), right channel (Channel = 2) or both channels (Channel = Both).



If a single-channel measurement is selected (Ch1 or Ch2), the data content of the other channel is not taken into consideration.

"1" Only the signal on the left channel is measured.

"2" Only the signal on the right channel is measured.

"Both" Both channels are measured (stereo).

Remote command:
`INPut<n1>:CHANnel` on page 694

Audio Bits
Word width used by the digital audio analyzer in the Meas Mode "Audio Data".

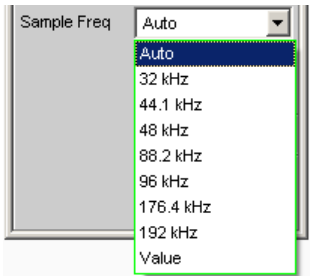
Value range: 8 ... 24

If the word width is reduced, the values of the audio samples are trimmed down to the specified word width. Reduced word width results in a corresponding reduction in dynamic range.

Remote command:
`INPut<n1>:AUDiobits` on page 694

Sample Freq
Used to set the clock rate of the digital audio signal for the analyzer.

The sample frequency setting is used as a reference for all audio data frequency measurements.



If the entered frequency does not correspond to the applied frequency, all filters and frequency measurements are shifted accordingly with respect to frequency.

Value range for numeric input:

30 kHz ... 200 kHz

Standard sampling frequencies can be set directly in the selection field.

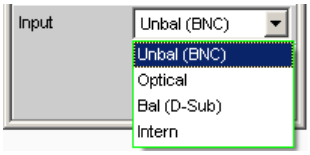
"Auto"	The sampling rate is measured, set and displayed in the following line. If the applied sampling rate is changed the set value is automatically updated. **Note:** The digital analyzer must re-initialized for each new sampling frequency. To avoid the need to repeat this time-consuming procedure too often, minor deviations and fluctuations (below 3 Hz) are ignored.
"32 kHz to 192 kHz"	Standard sampling rate 32 kHz to 192 kHz
"Value "	Variable input of sampling rate

Remote command:
`INPut<n1>:SAMPle:FREQuency:MODE` on page 694
`INPut<n1>:SAMPle:FREQuency` on page 694

Pre Filter
The selected prefilter affects all measurement functions. This permits desired prefiltering without selecting appropriate filters for the individual measuring functions.

Remote command:
INPut<n1>:FILTer on page 737

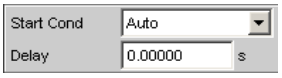
Input
Selection of the input interface for the Digital Audio Analyzer with the R&S UPP B2 (digital audio interfaces) option



"Unbal (BNC)"	Unbalanced digital audio input at the BNC socket
"Optical"	Optical digital audio input (TOSLINK).
"Bal (D-Sub)"	Balanced digital audio input at the D-Sub male connector on the front panel
"Intern"	Internal connection to the Digital Audio Generator Loop measurement possible without connected cable.

Remote command:
INPut<n1>:TYPE on page 694

Start Cond
Specifies the event which triggers a measurement.

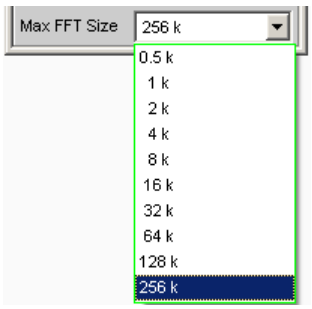


After the Start Cond has been selected, measurement either begins immediately (Auto) or only when the desired trigger condition is fulfilled; for details see chapter 5.16, "Start Conditions", on page 328.

Delay
Delay for Start Cond.

A delay time can be entered for the Start Cond Auto menu item; for details see chapter 5.16, "Start Conditions", on page 328.

Max FFT Size
Used to limit automatic zoom fitting for the FFT size for all FFT-supported measurement functions (e.g. THD, THD+N, DFD, each with Post FFT) to the selected value with the goal of increasing measurement speed.



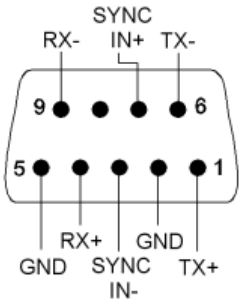
The limit to the FFT size is particularly useful for external sweeps for adapting the measuring time to the time frame of an external time tick. A limit is usually associated with degradation in measuring accuracy since incidents such as carrier-level noise can no longer be completely recorded.

Remote command:
SENSe<n1>:MAX:FFT:SIZE on page 692

5.12.2 Interface Assignment

Use of the R&S UPP B2 (digital audio interfaces) option for 2-channel analysis.

DIGITAL BAL plug (9-pin D-Sub connector)



Connection	Signal	Input (I) Output (O)	Description
1	TX+	A	Transmitter output Bal+
2	GND		Ground terminal
3	SYNC IN-	E	Synchronization input Bal-
4	RX+	E	Receiver input Bal+
5	GND		Ground terminal
6	TX-	A	Transmitter output Bal-
7	SYNC IN+	E	Synchronization input Bal+
8			
9	RX-	E	Receiver input Bal-

Use of the R&S UPP B4 (HDMI and digital audio interfaces) option for 2-channel and analysis.

DIGITAL OUT

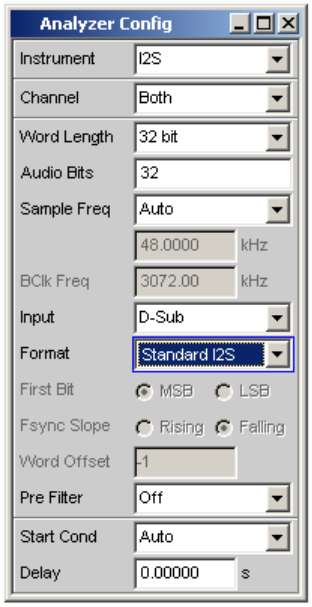
BNC output for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical output according to TOSLINK system

DIGITAL IN

BNC input for the SPDIF or AES/EBU format according to EIAJ CP-340 and optical output according to TOSLINK system

5.13 Configuring the I²S Analyzer

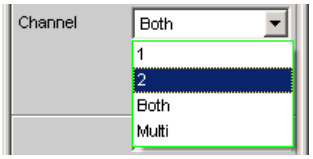
5.13.1 I²S Analyzer Configuration Panel



The "I²S" analyzer instrument requires the R&S UPP B2 option (digital audio interface) or the R&S UPP B4 option (HDMI and digital audio interfaces) for 2-channel and 8-channel "I²S" analysis respectively.

A difference in the Config panel due to the installation of the R&S UPP B2 (digital audio interfaces) or R&S UPP B4 (HDMI and digital audio interfaces) options applies only to the "Channel" command with the "Multi" option, which is offered only for 8-channel "I²S" generation.

Channel
Used to set the active measurement channel.



If a single-channel measurement is selected (1 or 2), the data content of the other channel is not taken into consideration.

"1" Only the signal on the left channel is measured.

"2" Only the signal on the right channel is measured.

"Both" Both channels are measured (stereo).

"Multi" This selection item is offered only if the R&S UPP B4 (HDMI and digital audio interface) option for 8-channel "I²S" analysis is installed and enables the free configuration of up to 8 channels in the following parameter fields.

Remote command:
`INPut<n1>:CHANnel` on page 694

Meas Channels
Setting of the respectively active analyzer channel.

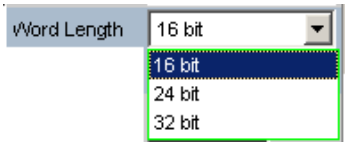
The free configuration of up to 8 channels is provided if the R&S UPP B4 (HDMI and digital audio interfaces) option for 8-channel "I²S" analysis is installed and if the "Multi" parameter field above has been selected.

"1-8" The corresponding analyzer channel is switched on or off.

Remote command:
`OUTPut:MCHannels<n2>` on page 664

Word Length
Word length of a data frame for each channel.

Value range: 16, 24, 32

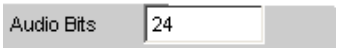


Remote command:
`INPut<n1>:WLENgth` on page 696

Audio Bits
Word width of audio data that is analyzed.

If the word width is reduced, the values of the audio samples are trimmed down to the specified word width. Reduced word width results in a corresponding reduction in dynamic range.

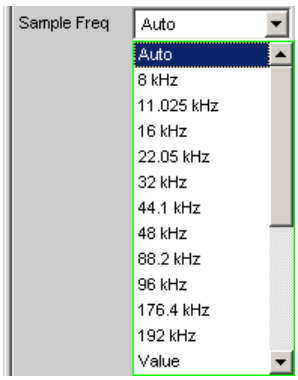
Value range: 8 to Word Length



Remote command:
`INPut<n1>:AUDiobits` on page 694

Sample Freq
Setting the sampling frequency.

The sampling frequency corresponds to the frequency of the FSYNC signal. All frequency information of measured audio data relates to this setting.



If the selected frequency does not correspond to the applied frequency, all filters and frequency measurements are shifted accordingly with respect to frequency.

Standard sampling frequencies can be set directly in the selection field.

"Auto" The sampling rate is measured, set and displayed in the following line. If the applied sampling rate is changed the set value is automatically updated.

Note: The digital analyzer must re-initialized for each new sampling frequency. To avoid the need to repeat this time-consuming procedure too often, minor deviations and fluctuations (below 3 Hz) are ignored.

"8 kHz to 192 kHz" Standard sampling rates 8 kHz ... 192 kHz

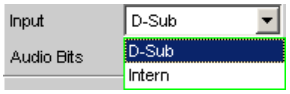
"Value:" Variable input of sampling rate
Value range for numeric input: 6.75 kHz to 200 kHz

Remote command:
`INPut<n1>:SAMPle:FREQuency:MODE` on page 694
`INPut<n1>:SAMPle:FREQuency` on page 694

BClk Freq
Displays the bit clock frequency. This is calculated from Sample Freq" * "Word Length" * 2.

Remote command:
`INPut<n1>:BCLK:FREQuency?` on page 695

Input
Used to select the data source for the I²S audio analyzer:

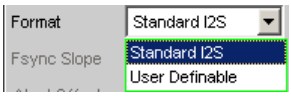


"D-Sub" The D-Sub connector is selected as the input.

"Intern" The internal generator is selected as the input. A loop measurement can be performed without a connected cable being required (loop-back test).

Remote command:
`INPut<n1>:INPut` on page 696

Format
Selection of the I²S analyzer format



"Standard I²S" The I²S analyzer receives in the standard I²S format. The following parameters that have an effect on the format have fixed default settings:
Fsync Slope .... Left(1) = Falling
Word Offset .... -1

"User-definable" The I²S analyzer receives in a format similar to I²S.
The following format-influencing parameters are additionally available:
Fsync Slope
Word Offset

Remote command:
`INPut<n1>:FORMat` on page 695

First Bit
Used to define the data bit receiving sequence

"MSB" The most significant data bit is received first.

"LSB" The least significant data bit is received first.

Remote command:
`INPut<n1>:FBIT` on page 695

Fsync Slope
Polarity of the Fsync signal.

"Rising" With a word offset of 0 a rising signal edge indicates the word beginning of the left data word (channel 1).

"Falling" With a word offset of 0 a falling signal edge indicates the word beginning of the left data word (channel 1).

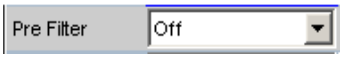
Remote command:
`INPut<n1>:FSLope` on page 695

Word Offset
By using Word Offset, you can set the number of the SCK cycles by which the Fsync signal is analyzed with delay with respect to the audio data.

Value range: -Word Length to 0 to +Word Length-1

Remote command:
`INPut<n1>:WOFFset` on page 696

Pre Filter
The selected prefilter affects all measurement functions. This permits desired prefiltering without selecting appropriate filters for the individual measuring functions.



Remote command:
`INPut<n1>:FILTer` on page 737
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

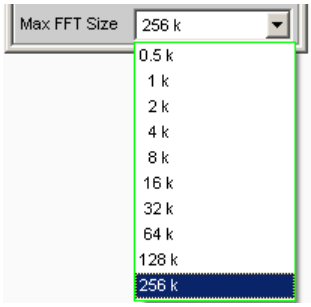
Start Cond
Specifies the event which triggers a measurement.

After the Start Cond has been selected, the measurement either begins immediately (Auto) or only when the desired trigger condition is fulfilled; for details see chapter 5.16, "Start Conditions", on page 328.

Delay
Delay for Start Cond.

A delay time can be entered for the Start Cond Auto menu item; for details see chapter 5.16, "Start Conditions", on page 328.

Max FFT Size
Used to limit automatic zoom fitting for the FFT size for all FFT-supported measurement functions (e.g. THD, THD+N, DFD, each with Post FFT) to the selected value with the goal of increasing measurement speed.

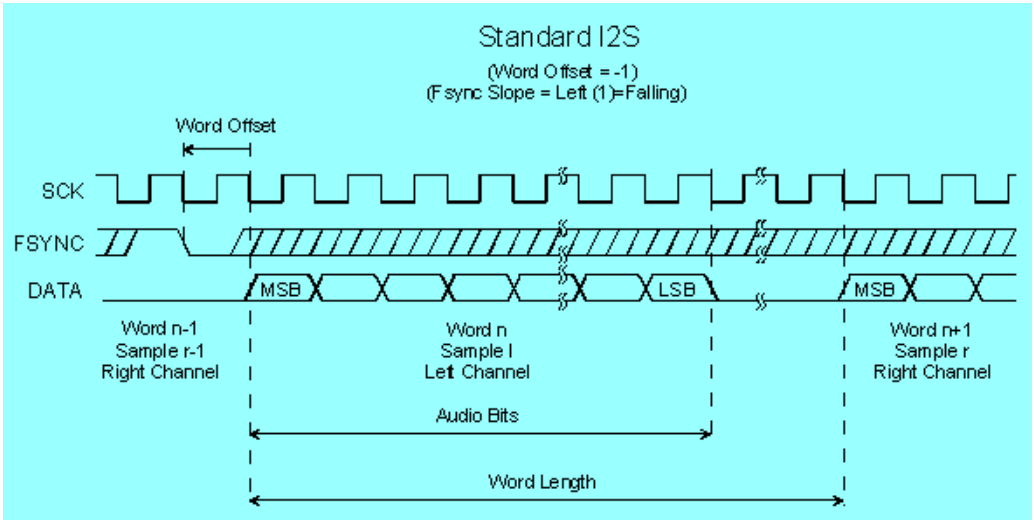


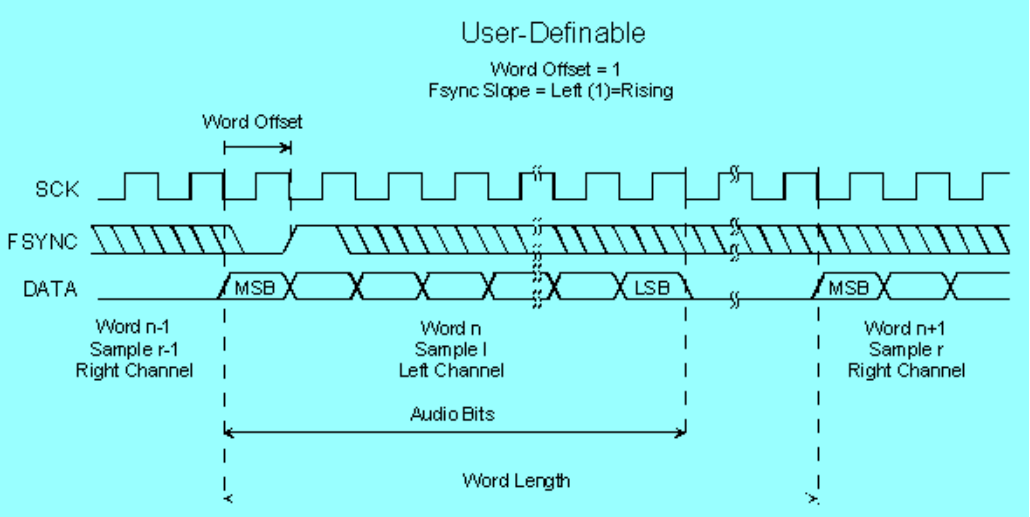
The limit to the FFT size is particularly useful for external sweeps for adapting the measuring time to the time frame of an external time tick. A limit is usually associated with degradation in measuring accuracy since incidents such as carrier-level noise can no longer be completely recorded.

Remote command:
`SENSe<n1>:MAX:FFT:SIZE` on page 692

5.13.2 Timing Diagrams

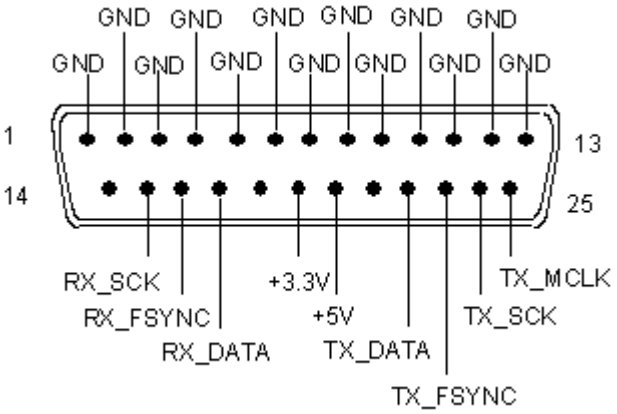
A number of configuration examples are shown in the timing diagrams below which illustrate the effect of some parameters.





5.13.3 Interface Assignment

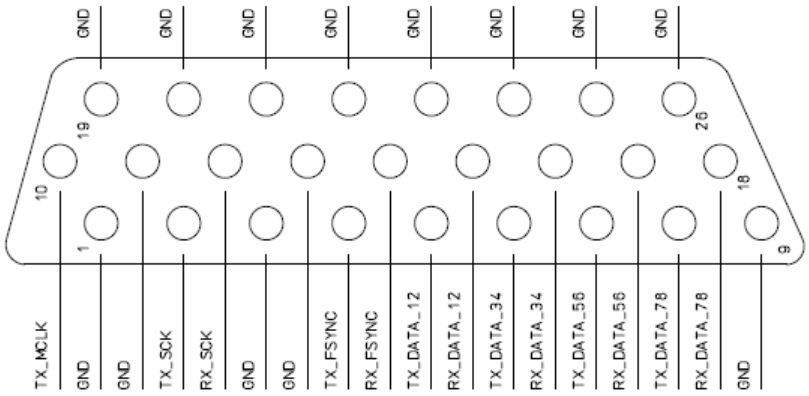
I²S plug (25-pin D-Sub connector) when using the R&S UPP B2 (digital audio interfaces) option for 2-channel analysis.



Connection	Signal	Input (I) Output (O)	Description
1	GND		Ground terminal
2	GND		Ground terminal
3	GND		Ground terminal
4	GND		Ground terminal
5	GND		Ground terminal
6	GND		Ground terminal
7	GND		Ground terminal
8	GND		Ground terminal

Connection	Signal	Input (I) Output (O)	Description
9	GND		Ground terminal
10	GND		Ground terminal
11	GND		Ground terminal
12	GND		Ground terminal
13	GND		Ground terminal
14	not connected		
15	RX_SCK	E	Serial Clock Analyzer
16	RX_FSYNC	E	Frame Sync Analyzer
17	RX_DATA	E	Serial Data Analyzer
18	not connected		
19	+3.3 V (500 mA)	A	Power Supply
20	+5 V (500 mA)	A	Power Supply
21	not connected		
22	TX_DATA	A	Serial Data Generator
23	TX_FSYNC	A	Frame Sync Generator
24	TX_SCK	A	Serial Clock Generator
25	TX_MCLK	A	Master Clock Output Generator

I²S plug (26-pin D-Sub connector) when using the R&S UPP B4 (HDMI and digital audio interfaces) option for 8-channel generation.



Connection	Signal	Input (I) Output (O)	Description
1	GND		Ground terminal
2	TX SCK	A	Serial Clock Generator

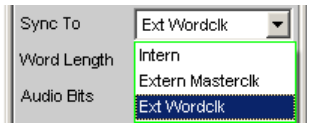
Connection	Signal	Input (I) Output (O)	Description
3	GND		Ground terminal
4	TX FSYNC	A	Frame Sync Generator
5	TX DATA Ch 1,2	A	Serial Data Generator Ch1,2
6	TX DATA Ch 3,4	A	Serial Data Generator Ch3,4
7	TX DATA Ch 5,6	A	Serial Data Generator Ch5,6
8	TX DATA Ch 7,8	A	Serial Data Generator Ch7,8
9	GND		Ground terminal
10	TX MCLK	A	Master Clock Output Generator
11	GND		Ground terminal
12	RX_SCK	E	Serial Clock Analyzer
13	GND		Ground terminal
14	RX FSYNC	E	Frame Sync Analyzer
15	RX DATA Ch 1,2	E	Serial Data Analyzer Ch 1,2
16	RX DATA Ch 3,4	E	Serial Data Analyzer Ch 3,4
17	RX DATA Ch 5,6	E	Serial Data Analyzer Ch 5,6
18	RX DATA Ch 7,8	E	Serial Data Analyzer Ch 7,8
19	GND		Ground terminal
20	GND		Ground terminal
21	GND		Ground terminal
22	GND		Ground terminal
23	GND		Ground terminal
24	GND		Ground terminal
25	GND		Ground terminal
26	GND		Ground terminal

SYNC IN (BNC jack)

Connection	Signal	Input (I) Output (O)	Description
Outer conductor	GND		Ground terminal
Inner conductor	TX_CLK	E	Sync Input Generator

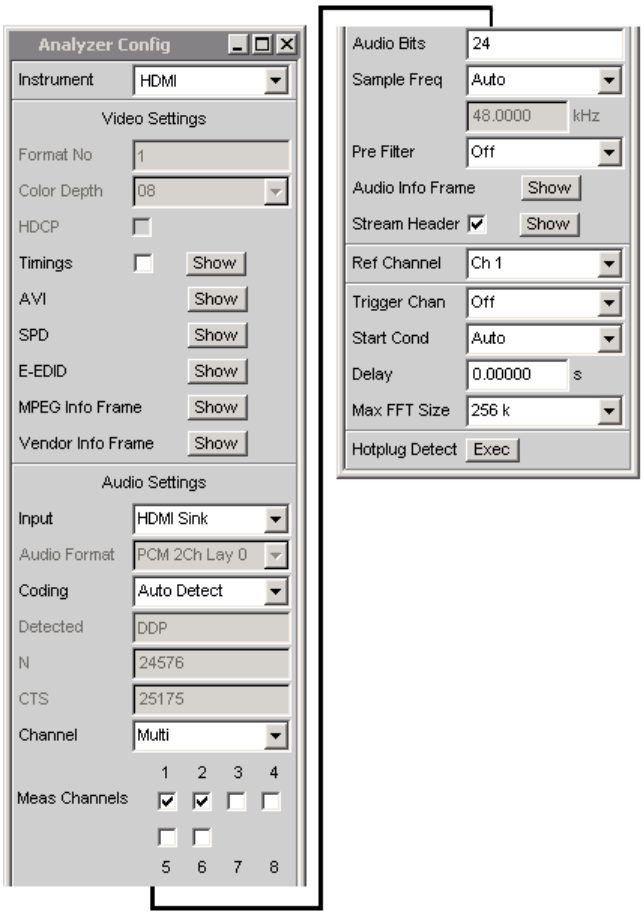
An external master clock or an external word clock is fed in at the SYNC IN BNC jack of the R&S UPP B2 (digital audio interfaces) or R&S UPP B4 (HDMI and digital audio

interface) option. The desired clock is selected in the parameter field "Sync To " with "Extern Masterclk " or "Ext Wordclk ".



5.14 Configuring the HDMI Analyzer

5.14.1 HDMI Analyzer Configuration Panel



The Config panel enables the settings for the digital HDMI analyzer whose configuration is described below. The HDMI analyzer is available with the option R&S UPP B4 (HDMI and digital audio interfaces) only.

Format No
Video identification code of the supplied video signal according to CEA-861. The ID code is extracted directly from the AVI Info Frame of the connected HDMI source.

Remote command:
SENSe<n1>:HDMI:VIDeo:FORMat on page 698

Color Depth
Color depth of the supplied video format. This information is extracted from the General Control Packet of a connected HDMI source.

"8, 10, 12" Color depth of the supplied video format.

Remote command:
SENSe<n1>:HDMI:VIDeo:COLor:DEPTh on page 698

HDCP
Indicates whether the A/V signal of a connected HDMI source is encrypted or not.

"On/off" HDCP is switched on or off

Remote command:
SENSe<n1>:HDMI:HDCP on page 697

Timings

Available only with the R&S UPP K45 (expanded audio/video measurements) option.

The "Show" button opens a measurement display in which the frequencies of Pixel Clock, HSync and VSync as well as their time reference are displayed. Deviations of these parameters from the values specified for this format are highlighted in color as errors based on the CEA-861 standard.

If the box is checked, the video timing analysis is carried out, but the measuring speed is reduced. The measured value display is updated, provided it has been opened using the "Show" button. If high measurement speed is important, this should be unchecked.

Remote command:
SENSe<n1>:HDMI:VIDeo:TIMing on page 698

AVI

Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a window in which the content of the AVI Info Frame of a connected HDMI source is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

SPD

Available only with the R&S UPP K45 (expanded audio/video measurements) option.

Opens a window in which the content of the SPD Info Frame of a connected HDMI source is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

E-EDID

Opens a window that shows the data structure of the HDMI analyzer of the R&S UPP of an HDMI source connected to the SINK socket. The data of the R&S UPP can be edited, for example to check how connected HDMI sources react to these settings. The structure of the E-EDID is specified in the VESA Enhanced Extended Display Identification Data standard.

MPEG Info Frame

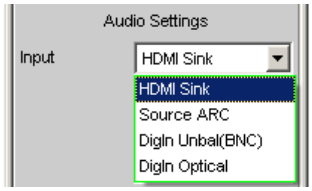
Opens a window in which the content of the MPEG Info Frame of a connected HDMI source is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

Vendor Info Frame

Opens a window in which the content of the Vendor Specific Info Frame of a connected HDMI source is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

Input

Selection of the audio source.



"HDMI Sink" Audio source is the HDMI SINK socket.
By default, the audio data are received and analyzed via the HDMI SINK socket in the HDMI analyzer.

"Source ARC" Audio source is the Audio Return Channel supplied via the SOURCE socket.
The Audio Return Channel (ARC) can be analyzed as an alternative. In this mode, the audio signal supplied to the HDMI 1.4 load connected to the SOURCE socket is analyzed in the audio analyzer.

"DigIn Unbal" Audio source is the Digital IN BNC socket.
In addition to the "HDMI Sink" and "Source ARC" HDMI interfaces, the interface of the DIGITAL IN BNC jack digital audio analyzer can also be selected here. This also makes it possible to use the decoding function for encoded signals (see "Coding" on page 314) on this interface. This also makes it possible to switch this digital input without changing instruments.

"DigIn Optical" Audio source is the Digital IN TOSLINK socket.
In addition to the "HDMI Sink" and "Source ARC" and HDMI interfaces, you can also select the interface of the DIGITAL IN-TOSLINK socket digital audio analyzer here. This makes it possible to also use the decoding function for encoded signals (see "Coding" on page 314) on this interface. This also makes it possible to switch this digital input without changing instruments.

Remote command:
`SENSe<n1>:HDMI:AUDio:INPut` on page 697

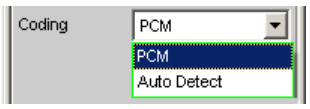
Audio Format
HDMI layout of the supplied audio data.

"PCM Lay 0" 2 channels with PCM data or compressed audio.

"PCM Lay 1" 8 channels with PCM data.

Remote command:
`SENSe<n1>:HDMI:AUDio:FORMat` on page 697

Coding
Selection of the decoder functionality.



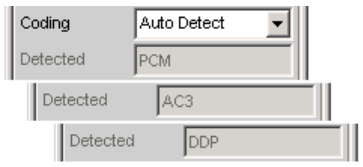
The analysis of **Dolby** formats is available with the R&S UPP K41 option (Dolby decoding) only.

"PCM" Incoming audio data are directly analyzed.

"Auto Detect" The format of the audio data received is detected automatically, and encoded audio signals are decoded. The format can be detected only if the samples are not zero samples. For PCM encoded data, the "Auto Detect" setting should be avoided to prevent unnecessary internal signal delays and to increase measurement speed. The determined decoding method is displayed in the next line.
The Audio Monitor is not available in "Auto Detect" mode.

Remote command:
`SENSe<n1>:HDMI:AUDio:CODing` on page 697

Detected
Display field in which the determined decoding method is displayed.



The analysis of **Dolby** formats is available with the R&S UPP K41 option (Dolby decoding) only.

This display field appears only if "Coding = Auto Detect" was selected in the parameter field above it.

N

The parameter N is required by an HDMI load for the regeneration of the audio master clock. It describes a fractional-rational ratio of the audio master clock to the video pixel clock.

According to the HDMI 1.4 specification, the N parameter is calculated according to the following relationship:

$$128*f_S / 1500Hz \leq N \leq 128*f_S / 300Hz$$

Remote command:
`SENSe<n1>:HDMI:AUDio:N` on page 697

CTS

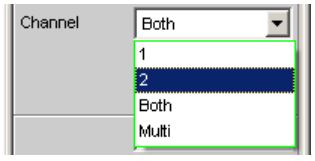
The parameter CTS is required by an HDMI load for the regeneration of the audio master clock. It describes a fractional-rational ratio of the audio master clock to the video pixel clock.

According to the HDMI 1.4 specification, the CTS parameter is calculated according to the following relationship:

$$(\text{Average CTS value}) = (f_{TMDS\_clock} * N) / (128 * f_S)$$

Remote command:
`SENSe<n1>:HDMI:AUDio:CTS` on page 697

Channel
Selection of the channels to be analyzed.



If a 2-channel audio format (PCM 2Ch Lay 0) is supplied, the following selection box is provided. For an 8-channel audio format (PCM 8Ch Lay 1), this selection box disappears and 8 Meas Channel checkboxes are provided. The analyzer is in Channel Multi mode internally.

"1" Only signal on channel 1 is measured.

"2" Only signal on channel 2 is measured.

"Both" Channel 1 and 2 are measured. (Stereo).

"Multi" Enables the selection of channels via checkboxes.

Remote command:
`INPut<n1>:CHANnel` on page 694

Meas Channel
Selection of audio channels to be measured.

Depending on the number of channels of the supplied audio format, the options of these checkboxes change.

Remote command:
`INPut<n1>:MCHannels<n2>` on page 692

Audio Info Frame

Opens a window in which the content of the Audio Info Frame of a connected HDMI source is shown. The data structure of this Info Frame is specified in the CEA-861 standard.

Stream Header

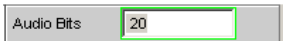
Available only with the R&S UPP K45 (expanded audio/video measurements) option.

The "Show" button opens a window in which audio-relevant information of the HDMI stream header are displayed. This data structure consists of the channel status bytes 0 to 4 of a consumer format according to IEC 60958. Refer also to chapter 5.29, "Protocol Analysis", on page 417.

If the box is checked, the protocol analysis is carried out, but this reduces measurement speed. The window is updated provided it has been opened via the "Show" button. If high measurement speed is important, this should be unchecked.

Remote command:
SENSe8:FUNCtion ON | OFF

Audio Bits



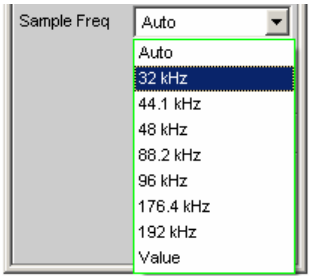
Word length used.

Value range: 8 ... 24

Remote command:

`INPut<n1>:AUDiobits` on page 694

Sample Freq



Setting of the audio sampling rate of the HDMI analyzer used for analysis. With the "Auto" selection, the sampling rate of incoming audio data is automatically determined and used for the analysis.

"Auto" The sampling rate present is automatically determined and set.

Note: The HDMI analyzer must re-initialized with every new sampling frequency. To avoid the need to repeat this time-consuming procedure too often, minor deviations and fluctuations (below 3 Hz) are ignored.

"32...192 kHz" Standard sampling rates 32...192 kHz

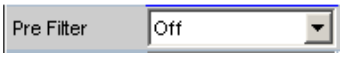
"Value:" Variable input of sampling rate
Value range for numeric input: 30.72 kHz ... 192 kHz

Remote command:

`INPut<n1>:SAMPle:FREQuency:MODE` on page 694

`INPut<n1>:SAMPle:FREQuency` on page 694

Pre Filter



The selected prefilter affects all measurement functions. This permits desired prefiltering without selecting appropriate filters for the individual measuring functions.

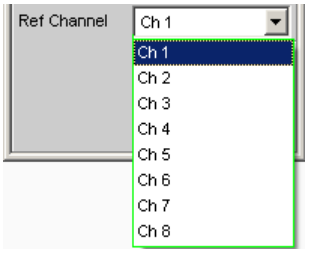
Remote command:

`INPut<n1>:FILTer` on page 737

For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Ref Channel

Reference channel for phase measurements, channel-specific measurements such as common-channel selectivity and the like.

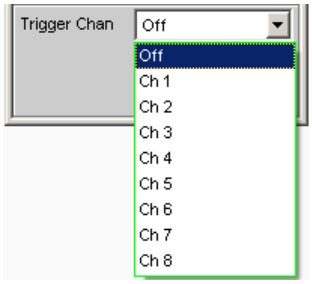


Each measuring channel can be selected as a reference channel. If a channel which is specified as a reference channel is not yet active (switched off) the channel is automatically switched on.

Switching off a measuring channel that was selected as the reference channel is prevented, and the user is advised of this by the following warning: It is not possible to switch off a Meas Channel if it is used as the Ref Channel!

Remote command:
SENSe<n1>:REFerence<n2>:CHANnel on page 703

Trigger Chan
Used to select the channel whose event triggers a measurement.



If a measuring channel which was inactive is selected as a trigger channel it is automatically switched on.

If the channel selected as a trigger channel is switched off, a warning appears. Upon confirming it, the trigger channel is set the same as the reference channel.chapter 5.16, "Start Conditions", on page 328.

Remote command:
TRIGger:CHANnel on page 703

Start Cond
Specifies the event which triggers a measurement.

Depending on the "Start Cond" selected, the measurement either begins immediately (Auto) or only when the desired trigger condition is fulfilled; for details see chapter 5.16, "Start Conditions", on page 328.

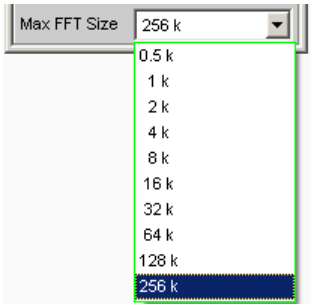
Remote command:
TRIGger:SOURce on page 704

Delay
Delay for Start Cond.

You can enter a delay for the "Start Cond Auto" menu item. For details, see chapter 5.16, "Start Conditions", on page 328.

Remote command:
TRIGger:DELay on page 703

Max FFT Size

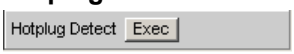


Used to limit automatic zoom fitting for the FFT size for all FFT-supported measurement functions (e.g. THD, THD+N, DFD, each with Post FFT) to the selected value with the goal of increasing measurement speed.

The limit to the FFT size is particularly useful for external sweeps for adapting the measuring time to the time frame of an external time tick. A limit is usually associated with degradation in measuring accuracy since incidents such as carrier-level noise can no longer be completely recorded.

Remote command:
SENSe<n1>:MAX:FFT:SIZE on page 692

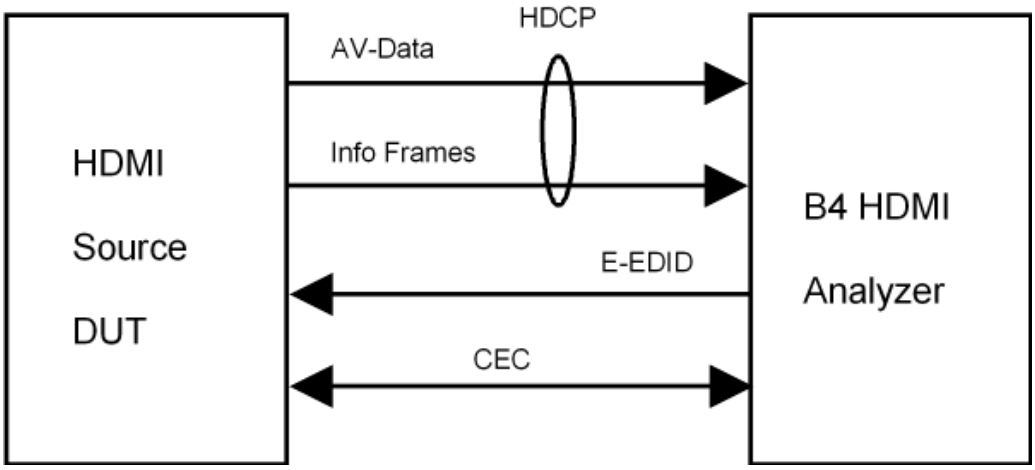
Hotplug detect



Toggles the Hotplug Detect Signal and thus causes a reset of the HDMI interface of a connected source.

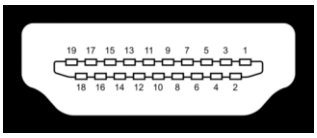
Remote command:
INPut<n1>:RESYnc on page 697

5.14.2 Signal flow between DUT and R&S UPP



5.14.3 Interface Assignment of HDMI

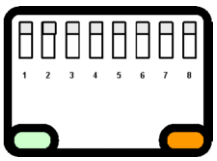
All HDMI sockets follow the standard assignment for HDMI 1.4.



Pin	Signal	Pin	Signal
1	TMDS Data2+	11	TMDS Clock Shield
2	TMDS Data2 Shield	12	TMDS Clock–
3	TMDS Data2–	13	CEC
4	TMDS Data1+	14	Reserved (HDMI 1.0-1.3c), HEC Data- (Optional, HDMI 1.4+ with Ethernet)
5	TMDS Data1 Shield	15	SCL (I²C Serial Clock for DDC)
6	TMDS Data1–	16	SDA (I²C Serial Data Line for DDC)
7	TMDS Data0+	17	DDC/CEC/HEC Ground
8	TMDS Data0 Shield	18	+5 V Power (max 50 mA)
9	TMDS Data0–	19	Hot Plug Detect (all versions), HEC Data+ (Optional, HDMI 1.4+ with Ethernet)
10	TMDS Clock+		

5.14.4 Interface Assignment of HEC

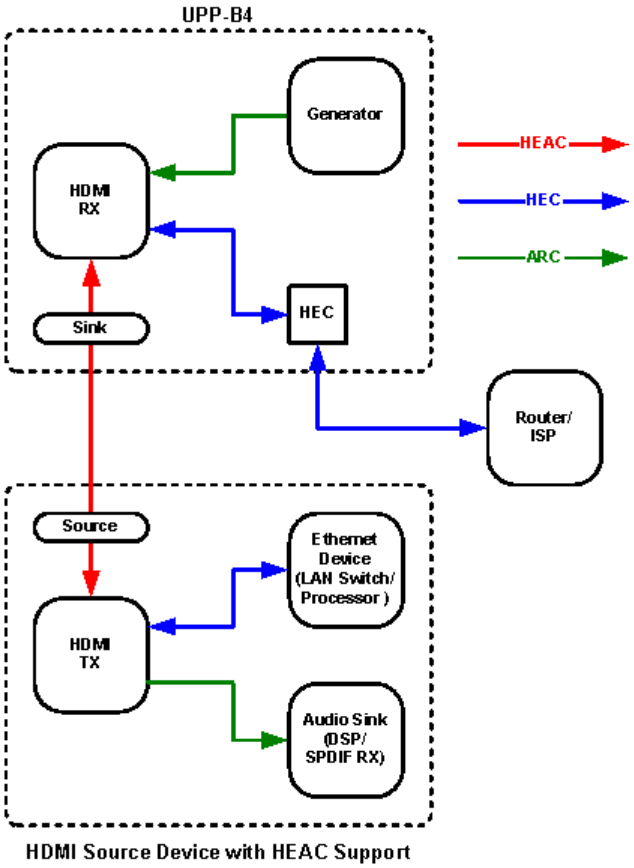
All Ethernet sockets follow the RJ-45 standard assignment.



Pin	Signal
1	TX+
2	TX-
3	RX+
4	NC
5	NC
6	RX-
7	NC
8	NC

5.14.5 HEAC Support

The HDMI analyzer supports the Audio Return Channel (ARC) as well as the HDMI Ethernet Channel (HEC). The following block diagram illustrates the internal wiring:



HDMI Source Device with HEAC Support

The settings for "Sink ARC" are performed in the Config panel for the "Digital Audio" generator instrument, see "Sink ARC" on page 198.

As the signal source for the Audio Return Channel, the supplied audio signal can either be directly looped through, or the internally generated signal of the digital audio generator can be selected.

To test the Ethernet functionality of a device under test, the HEC (Sink) RJ-45 socket can be used.

5.15 Starting Measurements

Measurements are started - and stopped - in manual mode using the keys CTRL+F5 (Start), CTRL+F6 (Single) or CTRL+F7 (Stop/Cont) on the external keypad, or by using the buttons "Start ", "Single " and "Stop/Cont " on the toolbar.

The effect of these keys or buttons depends on whether or not the sweep system is active:

- The measurement system can only be directly controlled using the keys if the sweep system is inactive.
- If, however, the sweep system is active, the measurement system is controlled by the sweep system and the keys or buttons are used to control the sweep system.

5.15.1 Overview of the Measurement System

The following information refers to a "deactivated sweep system", i.e. a sweep is not activated in either the generator or the analyzer.

A measurement, in a narrower sense, is the one-off or continuous "recording of measured values" for all activated measurement types. It can take the form of a single measured value or a data set (sample in the time domain, spectral lines in the frequency domain).

The one-off recording of measured values is referred to as a "single measurement" (see chapter 5.15.3.2, "Single measurement", on page 326), and continuous recording as "continuous measurement " (see chapter 5.15.3.1, "Continuous measurement", on page 325).

The measurement system is controlled

- explicitly via the keys and buttons described in the introduction
- implicitly by means of **termination events**. These are events (user entries) which invalidate the measurement currently being performed, i.e. changes in the generator, analyzer or filter bank. Following a termination event, the current measurement is restarted automatically. This ensures that the displayed measurement data is not corrupted by internal switching operations. Since it takes a few milliseconds to terminate and restart a measurement in progress, settings should not be entered in remote-control mode unless measurement has stopped.

5.15.2 Activating and Deactivating Measurement Types

With the R&S UPP it is possible to record up to 32 different **measured values** simultaneously and display them numerically and/or graphically.

These measured values are

- selected measurement functions of all channels,
- level monitor (RMS or DC downstream of the prefilter) of all channels,
- input monitor (peak measurement upstream of the prefilter) of all channels,
- frequency on channel 1, frequency, phase or group delay on all channels.

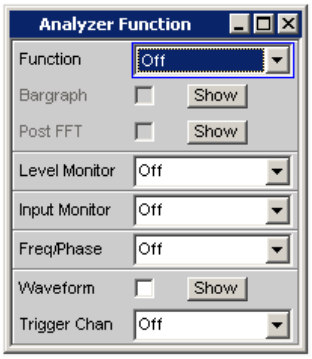
It is also possible to record a large number of **data sets** which can also be displayed numerically and/or graphically:

- Post FFT and/or bar graph for all channels with distortion measurements; frequency band analysis; FFT as measurement function,
- Waveform (display of the measurement signal in the time domain) of all channels.

Although the measurement types mentioned above are performed simultaneously and therefore affect each other only slightly with respect to time, it is only possible to display the results of these measurements in sequence.

It is therefore recommended to deactivate any measurement types that are not required in order to reduce the total measurement time:

- Unnecessary measurement times are avoided by deactivating unused channels.
- Deactivating individual measurement types (in the "Analyzer Function" panel) stops measurement results which are not required from being recorded and displayed.



All activated measurement types are measured in each (single) measurement. The measurement is not regarded as having been completed until all of the desired results (possibly also with settling) are available. Only then can the sweep be stepped or a triggered measurement result be retrieved by the remote control station. Consequently, the slowest measurement type determines the measurement speed of the entire instrument.

5.15.3 States of the Measurement System

The states of the measurement system are displayed above the 5th and 6th softkeys.

Two-channel analyzer

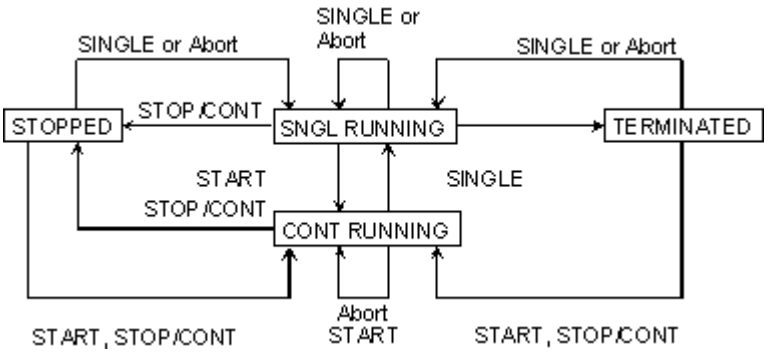
Multichannel analyzer

Table 5-2: The following states are possible:

Off	Channel is deactivated; measured values are not recorded on this channel.
Single	Single measurement in progress
Cont	Continuous measurement is being performed

Terminated	(Single) measurement terminated
Stopped	Measurement has been terminated; continuous measurement has been paused.

Further messages about the states of a current measurement, e.g. underrange or overrange information, can also be displayed. For more detailed information, see chapter 4.20, "Overview of Status Messages", on page 183.



5.15.3.1 Continuous measurement

This is the standard operating mode of the measurement system, and it is set each time the R&S UPP is switched on. The R&S UPP measures all activated measurement types continuously until one of the following events occurs:

START
START terminates the current measurement immediately, resets the MIN/MAX indicator, the MIN/MAX values, the limit violations of the measurement displays, and causes continuous measurement to be restarted.

Furthermore, starting or restarting a measurement also causes certain generator functions to restart:

- The sine-burst burst signal is reset, that is, it starts with the burst phase or burst on delay.
- The Play function starts again at the first sample in the WAV file.
- The Arbitrary function also starts again at the beginning.

Remote command:
`INITiate:CONTinuous` on page 700

SINGLE
SINGLE switches to single measurement. Each measurement type first completes the measurement that has already been started; when all measurement types have been completed, the measurement system is in the "Term" (terminated) state. Continuous measurement can be reactivated by pressing START or STOP/CONT.

Remote command:
`INITiate:CONTinuous` on page 700

STOP/CONT
STOP/CONT stops the current measurement immediately and causes the measurement system to enter the "Stop" state. Continuous measurement can be reactivated either with START or by pressing STOP/CONT again.

Remote command:
`INITiate:FORCe` on page 702

Termination event
.. stops the current measurement immediately and causes the continuous measurement to be restarted (see chapter 5.15.1, "Overview of the Measurement System", on page 323).

5.15.3.2 Single measurement

Each measurement type is performed once only; the measurement system then assumes the "Term" (terminated) state. The measurement does not necessarily have to produce a real result: if an error occurs during the measurement, the measurement result is classed as invalid. In such case, "----" rather than the measured value will be displayed in the associated result window. With remote control, a NAN ("not a number", 9.97e37) value will be returned.

Each single measurement must be triggered again by pressing SINGLE , or by a termination event.

In continuous single measurements, the control keys or buttons have the following functions:

START
START terminates the current measurement immediately, resets the MIN/MAX indicator, the MIN/MAX values, the limit violations of the measurement displays, and causes continuous measurement to be started.

Furthermore, starting or restarting a measurement also causes certain generator functions to restart:

- The sine-burst burst signal is reset, that is, it starts with the burst phase or burst on delay.
- The Play function starts again at the first sample in the WAV file.
- The Arbitrary function also starts again at the beginning.

Remote command:
`INITiate:CONTinuous` on page 700

SINGLE
SINGLE stops the current measurement immediately and causes the single measurement to be restarted.

Restarting the single measurement also causes a restart of the "sine burst" burst, that is, they start at the burst phase or "Burst on Delay".

Remote command:
`INITiate:CONTinuous` on page 700

STOP/CONT
STOP/CONT stops the current measurement immediately and causes the measurement system to enter the "Stop" state. Reactivating the single measurement with SINGLE .

Remote command:
`INITiate:FORCe` on page 702

Termination event
.. stops the current measurement immediately and causes the continuous measurement to be restarted (see chapter 5.15.1, "Overview of the Measurement System", on page 323).

5.15.3.3 Terminated measurement

The measurement system only assumes this state when a single measurement is terminated. No further measurements are performed; the measured values and data sets are frozen until the next measurement is started. Measured values should only be read out via the remote-control station when the system is in this state. The control keys have the following function:

START
START resets the MIN/MAX indicator, the Min/Max values and the limit violations of the measurement displays, and causes continuous measurement to be started.

Furthermore, starting or restarting a measurement also causes certain generator functions to restart:
- The sine-burst burst signal is reset, that is, it starts with the burst phase or burst on delay.
- The Play function starts again at the first sample in the WAV file.
- The Arbitrary function also starts again at the beginning.

Remote command:
`INITiate:CONTinuous` on page 700

SINGLE
SINGLE causes the start of a single measurement.

Restarting the single measurement also causes a restart of the "sine burst" burst signal, that is, it starts at the burst phase or "Burst on Delay".

Remote command:
`INITiate:CONTinuous` on page 700

STOP/CONT
STOP/CONT causes the start of continuous measurement.

Remote command:
`INITiate:FORCe` on page 702

Termination event
... stops the current measurement immediately and causes the continuous measurement to be restarted (see chapter 5.15.1, "Overview of the Measurement System", on page 323). In remote-control mode, the automatic measurement start is disabled so that setting commands can be dealt with at maximum speed.

5.15.3.4 Stopped measurement

The measurement system only assumes this state when STOP/CONT is pressed while a measurement is being performed. No currently valid measured values or data sets are available. Measured values should not be read out via the remote-control station when the system is in this state. The Control keys or buttons have the same function as when a measurement is terminated (see chapter 5.15.3.3, "Terminated measurement", on page 327).

5.16 Start Conditions

The Analyzer Config panel is used to define which conditions trigger the start of a measurement.

The menu item "Start Cond" defines when, how often or under what conditions measured values are to be recorded.

In addition to continuous operation, the following operating modes for recording measured values can be selected from this panel:

- Time-controlled measured value recording
- Externally controlled measured value recording (i.e. controlled by altering the measurement signal), known for short as "external sweeps"
- Level-controlled measured value triggering

When the conditions for measured value recording are met, the measured value is triggered, displayed in the measurement results panel and if appropriate stored in a measured value buffer internal to the device. The measured value list can be displayed numerically or graphically in one or more "sweep graphs" out of the available total of four.

In order for the measured value list to be recorded, the measured values of interest must be selected as traces (Y source) in the "Sweep Graph Config" panels. "X-axis" ("x-Source") should be set to "Sweep". Four sweep graphs with two traces each are available for measured value recording, so that a maximum of eight measured values can be recorded simultaneously.

5.17 Setting Start Condition

Ref Channel
Indicates the reference channel; only appears on multichannel analyzers.

The "Ref Channel" is the reference channel for measurements between two channels. They include the following measurements:

- Phase and group-delay measurement (the frequency measurement result is shown on the reference channel)

- Crosstalk measurements (ratio of two level measured values)

- Frequency tracking of selective RMS measurement

The reference channel cannot be switched off. If a reference channel that is not yet active is selected, then this channel is automatically switched on. Conversely, the attempt to switch off a channel that has been selected as the reference channel is rejected with a corresponding error message.

"Ch 1 / Ch 2 / Ch 3 ..." Selection of the reference channel from the parameter list.

Remote command:
`SENSe<n1>:REFerence<n2>:CHANnel` on page 703

Trigger Chan
Indicates the trigger channel; only appears on multichannel analyzers.

The "Trigger Chan" determines on which channel the trigger condition is tested.

The following are affected:

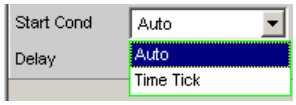
- The "Start Condition"
- The trigger source of the waveform monitors

If a channel that is not yet active is selected as the trigger channel, this channel is switched on automatically. If the measurement channel that is selected as the trigger channel is deactivated, then the trigger channel is automatically switched over to the reference channel.

Note: The parameter field for the trigger channel that is visible on the Waveform Monitor is identical to the field in the "Start Cond " area of the Analyzer Config panel.

"Off" No trigger channel is defined; the following restrictions apply: The waveform monitor operates in untriggered mode; "Trigger Source" is unavailable.

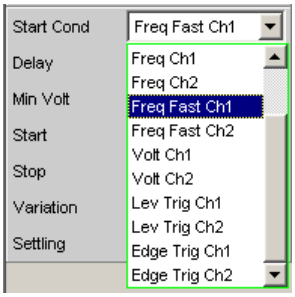
Only "Auto" or "Time Tick" can be selected as "Start Cond".



"Ch x" Selection of the trigger channel from the parameter list.

Remote command:
`TRIGger:CHANnel` on page 703

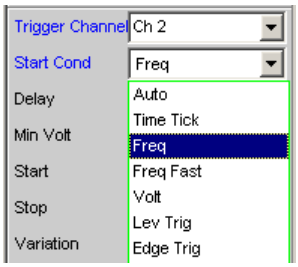
Start Cond
Specifies the event which triggers a measurement.



Depending on the "Start Cond" selected, the measurement starts either immediately (Auto) or only once the required trigger condition is met.

Note: With the two-channel analyzers, the trigger conditions appear together with the possible trigger channels in the parameter list; in this case, only the active channels are offered as trigger channels.

In the **multichannel analyzers**, first a trigger channel must be specified so that all start conditions are available. If the trigger channel is switched off, only "Auto" or "Time Tick" can be selected.



Note: With the multichannel analyzers, the trigger conditions appear in the parameter list without an explicit channel specification.

Note: If the reference points of a sweep are modified under the influence of the start condition during the sweep (e.g. due to over long measurement times during a time tick sweep), some sweep points may be outside of the visible x-axis of the sweep graphs.

A further Autoscale call at the end of the sweep will enter the new X limits in the sweep graph.

"Auto" Continuous measuring mode without trigger condition.
Values are recorded in the measured value buffer only if the frequency sweep for the selective RMS measurement or any type of generator sweep is active at the same time.
It is possible to switch between single and continuous measurements by pressing SINGLE or START if a sweep is not active.

"Time Tick" Time-controlled measured value recording; measured value triggering at fixed intervals. In the gap between time ticks, measurements are started, the measurement results are entered in the measured value buffer and displayed in the measurement results panel.
This start condition cannot be combined with a time-triggered generator sweep.
If time tick is combined with the frequency sweep of the selective RMS measurement or with a synchronous generator sweep, sweep stepping is performed as usual, but measurement starts only after the time tick has expired.

If neither the frequency sweep of the selective RMS measurement nor any generator sweep is active, the time tick defines the sweep x-axis:

- During the time tick sweep, the time stamps on the x-axis are updated and corrected if necessary (e.g. if a measurement lasts longer than the set time tick) and the individual measured values are entered according to their correct times.
- When START is pressed a series of periodic measured value recordings begins, and when the number of sweep points specified under "Points" is reached the series starts again from the beginning.
- When SINGLE is pressed, a single series of periodic measured value recordings begins. When the number of sweep points specified under "Points" is reached the sweep goes to "terminated" status.

"Time Chart" Time-controlled measured value recording; measured value acquisition at fixed intervals; not available in the multichannel analyzers. Measured values (from the currently running continuous measurement) are entered in a time chart in the timescale that can be entered under "Time." In contrast to "Time Tick", where at each tick a new (single) measurement starts and the result is only entered when the measurement ends, with "Time Chart" intermediate results can also be displayed. This is particularly desirable in the case of quasi peak measurements.

Note: If the chosen time grid (update rate) is shorter than the measurement time required for the measurement function, intermediate results are displayed. Otherwise, end results are displayed.

This start condition cannot be combined with a frequency sweep of the selective RMS measurement or a generator sweep. The time stamps of the measured value acquisition define the sweep x-axis:

- When START is pressed and immediately after the time chart sweep is switched on, a series of periodic measured value recordings begins. When the number of sweep points specified under "Points" is reached, the series starts again from the beginning.
- When SINGLE is pressed, a single series of periodic measured value recordings begins. When the number of sweep points specified under "Points" is reached the sweep goes to "terminated" status.

Note: The sweep starts as soon as time chart is switched on, that is, intermediate or end results of the selected continuous measurement are displayed and recorded at fixed intervals.

"Freq ..." Externally controlled measured value recording; measured value triggering when a significant frequency change occurs on the trigger channel (external frequency sweep); available on multichannel analyzers only if the trigger channel is switched on.
The measurement results are entered in the measured value buffer and displayed in the measurement results panel. The measured frequency is entered as an X value of the sweep.
This start condition cannot be combined with the frequency sweep of the selective RMS measurement. The sweep x-axis is always predefined by the external frequency sweep, even if the internal generator is generating the sweep signal.

- Clean signals
  For particularly fast frequency sweeps with clean signal (e.g. from CD), the Fast variant "Freq Fast", "Freq Fast Ch1", "Freq Fast Ch2" can be selected.
- Signals with high noise component
  If the signal has a high noise component, the slower but more precise measuring method "Freq", "Freq Ch1", "Freq Ch2" must be used. To achieve the shortest possible measuring times, the measurement of the trigger condition is done via an FFT with an FFT size that is automatically optimized to the expected signal frequency. If no frequency can be determined, then the FFT size is adjusted to the lowest expected frequency (start or stop value).

"Volt ..." Externally controlled measured value recording; measured value triggering when a significant level change occurs on the trigger channel (external level sweep); can be selected on multichannel analyzers only if the trigger channel is switched on.
The measurement results are entered in the measured value buffer and displayed in the measurement results panel. The measured level is entered as an X value of the sweep.
This start condition cannot be combined with the frequency sweep of the selective RMS measurement. The sweep x-axis is always predefined by the external level sweep, even if the internal generator is generating the sweep signal.

"Lev Trig ..." Measured value triggering due to a level detected on the trigger channel at the analyzer input; can be selected on the multichannel analyzers only if the trigger channel is switched on.
This start condition can be combined with any sweep and has no effect on the sweep x-axis.
Sweep stepping or - if the sweep system is inactive - pressing START or SINGLE alerts level monitoring to wait until a level in the range between start and stop is measured (level triggering). When this occurs a single measurement is started, if necessary after a specified delay.
In the case of continuous measurement, a further triggering in the specified range occurs only if the level has gone over or under the set range in the interim. This means that level monitoring is not put on alert again until a level outside of the specified range is detected.

"Edge ..." Measured value triggering due to a voltage edge detected at the analyzer input on the trigger channel; can only be selected in the multichannel analyzers if the trigger channel is switched on.
This start condition can be combined with any sweep and has no effect on the sweep x-axis.
Level monitoring is started by sweep stepping or - if the sweep system is inactive - by pressing START or SINGLE . However, it is not put on alert until a level beyond the start level (outside of the start-stop interval) is measured. Triggering occurs at the moment when the level first enters the range between start and stop (edge triggering). When this occurs a single measurement is started, if necessary after a specified delay.
In the case of continuous measurement, a further triggering in the specified range occurs only if in the interim the level has left the set range and moved in the direction of the start level. This means that level monitoring is not put on alert again until a level beyond the start level is detected.

Remote command:
`TRIGger:SOURce` on page 704

Delay
Delay for Start Cond.

You can enter a delay for the "Start Cond Auto" menu item.

It applies under the following conditions:
- Signal change on the generator (value entry, value change via rotary knob)
  Signal change on the generator by entering a value
- Performance of sweeps
- STOP/CONT or START (Continuous Measurement)
- SINGLE (Single Measurement)
- Change in the Analyzer panels
- Change in the Generator panels
- Change in the Filter panel

The "Delay" setting determines the time that must elapse between the above events and restarting of the measurement so that, for example, a DUT has sufficient time to settle. The total measuring time – i.e. the time that elapses until the measuring result is available – is thus increased by the specified delay.

Note: In the case of continuous measurement, a delay is only applied to the first measurement after the START. No delay is applied to subsequent measurements.

Note: If the overall delay (including internal delays) is greater than 2 s, the measurement will not be restarted automatically if changes are made at the generator, analyzer, or filter bank.

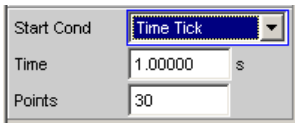
Note: The delay is applied to all measured channels. In the case of multichannel analyzers, the delay only extends the total measuring time of the first partial measurement

(first pair of channels); all further (measured offline) channel pairs can be measured without an additional time loss.

Remote command:
TRIGger:DELay on page 703

5.18 Time-Controlled Measured value Recording

In time-controlled measured value recording, the estimated total recording time is derived from the product of the time interval per measurement and the number of measured value acquisitions. The actual duration of the measured value recording may be considerably longer in the case of the time tick start condition if the value entered for the time tick is shorter than the required measurement time.



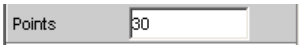
Time
Used for entering the time grid in which it is intended measurements should be started ("time tick") or measured values should be read ("time chart").

When the start condition is "Time Tick" the measurement has priority over the start of a new measurement. If the time tick is longer than the measurement time, the system waits for the next time tick after each single measurement. During this waiting time no measurement is performed. If the time tick is shorter than the measurement time, any time ticks occurring during a running measurement will be ignored. This means that measurements will be started at time intervals corresponding to an integer multiple (≥1) of the selected time tick.

When the start condition is "Time Chart" (not available in the multichannel analyzers) the measured value is read in the specified time grid, regardless of whether a new measured value is present. If the chosen time grid (update rate) is longer than the measurement time for the measurement function, then only end results are displayed. If the time grid is shorter than the measurement time, intermediate results are displayed if available. If no intermediate results are yet available, the last valid results are entered in the time chart again.

Remote command:
TRIGger:TIMer on page 704

Points
For entering the number of measured value recordings.



Time-controlled measured value recording ends as soon as the number of measured data items specified here are available.

Note: If the start condition "Time Tick" is combined with the frequency sweep of the selective RMS measurement or a synchronous generator sweep, the number of sweep points is taken from there and cannot be entered separately.

Remote command:
`TRIGger:COUNt` on page 703

5.19 External Sweeps and Level-Controlled Measured value Triggering

External sweeps are usually controlled by means of an external signal source. The internal sweep generator should not be active in this case. A warning message is output if the internal sweep generator is still active when an external sweep is activated.

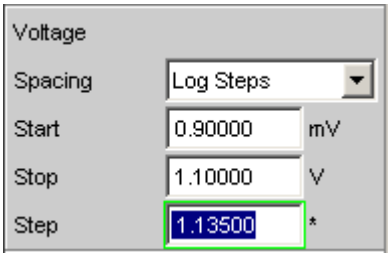
Basically, the internal sweep generator can be used as a signal source also with **external sweeps**. This is meaningful, for example, if the delay of the DUT is not known or not constant and it is, therefore, not possible to couple the generator stepping permanently to the measurement start. Sweep stepping is performed as usual, but measurement does not start until a trigger event occurs.

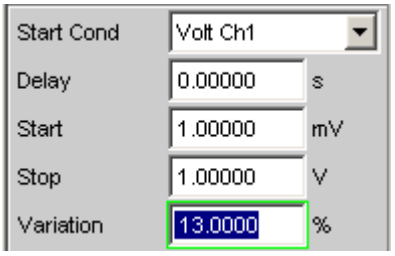
The generator should be stepped in a time-controlled manner (dwell sweep; setting in generator: "Next step" = "dwell value" or "dwell file"), in order to achieve independence from generator sweep stepping and measurement.

For analyzer-synchronous stepping (setting in generator: "Next Step" = "Anlr Sync"), it is important to ensure that each sweep step extends beyond the variation selected for the start condition. If this condition is not met, the external sweep comes to a stop.

The following rules must be followed for setting the generator sweep in the case of an external sweep:

- "Spacing" must be set to "Log Steps" (optional for dwell sweep).
- The sweep direction (specified by the sequence between "Start" and "Stop") must agree with the recording direction chosen in the analyzer.
- The sweep range must be within the recording range (optional for dwell sweep).
- The step width, or increment (specified in the generator as a factor under "Step") must be greater than "Variation" in the analyzer (optional for dwell sweep).
  for upward sweeps (Start < Stop): Step > 1 + Variation / 100
  for downward sweeps: (Start > Stop): Step < 1 – Variation / 100





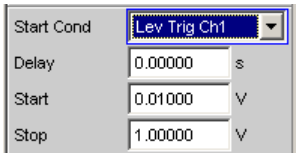
The sweep x-axis is always predefined by the external sweep, even if it is the internal generator that generates the sweep signal.

The start and stop values determine the sweep direction for external sweeps: If the start value is less than the stop value, an upward sweep is performed, otherwise a downward sweep will be performed.

Signal changes counter to the sweep direction affect continuous mode and single mode differently:

- If an external continuous sweep was started using START any significant change of frequency in the stop to start direction causes the sweep to restart.
- If an external single sweep was started using SINGLE , changes in the stop to start direction are interpreted as interference and ignored. A measured value beyond the stop value terminates the sweep.

Though using the internal generator for **level-controlled measured value triggering** is not actually prohibited, in most cases it gives no advantage.



In the case of **edge-sensitive triggering**, the triggering edge is defined by the start and stop values: If the start value is less than the stop value, triggering occurs on a positive edge, that is, at the exact moment when a value below "Start" is followed by a value above "Start."

Min Volt
This is used to enter a minimum level for external frequency sweeps. If the signal is below this threshold, no triggering occurs.

It prevents triggering at pauses in the signal. An excessively low minimum level would cause even frequency values measured in the noise to be used for triggering.

Remote command:
`ARM:LEVel:MIN` on page 705

Start
This is used to enter the start value for the recording interval (in the case of external sweeps) or for the trigger range (in the case of level triggering).

The start value should be selected so that the first value to be recorded lies within the start/stop interval even for measurement uncertainties.

If the start value is less than the stop value, the external sweep runs as an upward sweep; in the case of edge triggering the system awaits a positive edge. Measured values that are lower than "Start" are ignored.

If the present stop value is entered as the start value, the sweep direction is automatically reversed and the stop value is given the old start value.

Remote command:
`ARM:FREQuency:STARt` on page 704
`ARM:VOLTage:STARt` on page 705

Stop
This is used to enter the stop value for the recording interval (in the case of external sweeps) or for the trigger range (in the case of level triggering).

The stop value should be set to the expected full-scale value of the external sweep.

If the stop value is less than the start value, the external sweep runs as a downward sweep; in the case of edge triggering the system awaits a negative edge.

If the present start value is entered as the stop value, the sweep direction is automatically reversed and the start value is given the old stop value.

Termination condition:

For a scan to terminate correctly, the last measured value must exceed the specified stop value or approach it by less than the specified "variation" from the end value.

Note: Multiscan mode:
It must be ensured that the termination condition is met to ensure that all scans are stored.

Remote command:
`ARM:FREQuency:STOP` on page 705
`ARM:VOLTage:STOP` on page 705

Variation
For entering the relative change of frequency or level in the form of a percentage with effect from which a new measurement is triggered in the case of external sweeps. For external level sweeps the value can also be entered in dB.

The variation chosen should be some 5% to 10% smaller than the expected changes, so that on the one hand triggering will occur reliably and on the other hand will not occur on intermediate values.

The entered value is used to calculate the internal variation factor
- For upward sweeps: 1 + var/100
- For downward sweeps: 1 – var/100

Note: Due to the different variation factors for upward and downward sweeps, the number of sweep points in an upward sweep - given identical values for "Start", "Stop" and "Variation" - is somewhat greater than in a downward sweep.

In the case of continuous sweeps, a change by at least this value in the stop to start direction (i.e. counter to the sweep direction) causes measured value recording to restart.

The lower entry value takes account of the current start and stop values and is automatically limited so that regardless of the sweep direction a maximum of 1024 measured values can be recorded. Values of less than 0.1% cannot generally be entered.

Remote command:
`TRIGger:FREQuency:VARiation` on page 703
`TRIGger:VOLTage:VARiation` on page 704

5.20 Sweep Options

Besides the measurement system, the R&S UPP is also equipped with a comprehensive sweep system. This sweep system is enabled as a generator sweep system by activating a generator sweep or as an analyzer sweep system by activating the RMS selection sweep, and then takes control of the measurement system.

When a sweep system is activated, sweeps are started and also stopped in manual operating mode using the START , SINGLE and STOP/CONT keys or buttons.

Starting or restarting a sweep (via START) also causes certain generator functions to restart:

- The sine-burst burst signal is reset, that is, it starts with the burst phase or burst on delay.
- The Play function starts again at the first sample in the WAV file.
- The Arbitrary function also starts again at the beginning.

5.20.1 Overview of Sweep Options

The following information refers to **an activated sweep system**, i.e. a sweep is activated in either the generator or the analyzer.

Sweeps are measurement cycles in which the individual measurements are triggered by predefined generator and analyzer settings. The generator and analyzer sweeps can be defined either by entering the start value, stop value, spacing and points/step or by specifying a sweep list. Both methods ultimately define a **table of settings** (x-axis) which is processed when the sweep is started.

A one-off sweep is referred to as a **single sweep** and a continuously repeated sweep as a **continuous sweep**.

The **active sweep system is controlled**

- explicitly using START (Ctrl F5), SINGLE (Ctrl F6) and STOP/CONT (Ctrl F7)
- implicitly by means of "termination events". These are events (user entries) which invalidate the current measurement and, therefore, the current sweep, i.e. changes in the generator, analyzer or filter bank. Following a termination event, the current sweep is restarted automatically. This ensures that the recorded data sets are based on the same settings.

It is not possible to **control the measurement system** if the sweep system is activated. Exception: When a sweep has been terminated, STOP/CONT or a termination

event activates the continuous measurement (see chapter 5.20.3.3, "Terminated sweep", on page 343).

The R&S UPP offers many different sweep options, which are briefly summarized here:

- Generator sweep system: Time-synchronous sweeps (DWELL sweeps) and analyzer-synchronous sweeps (AUTO sweeps) and manual sweeps (MANU sweeps). They can also be 2-dimensional (provided that more than one sweepable parameter exists for the selected generator function), i.e. 2 generator parameters are varied. This is then referred to as a Z sweep because the z-axis is swept in addition to the x-axis.
- Analyzer sweep system: Analyzer-synchronous sweep of the RMS selection frequency.

All sweeps can be performed either as parameter sweeps with constant increment or as list sweeps.

5.20.2 Activating and Deactivating Sweeps

In the R&S UPP the desired sweep system is activated or deactivated directly on the associated function panel:

- A generator sweep under "Sweep Ctrl" in the Generator Function panel.
- Sweep of the tracking filter for the "RMS Selective" measurement function under "Sweep Ctrl" in the Analyzer Function panel.

Only one of the two sweep systems can be active at any one time. If the user activates a sweep while another sweep is already active, the sweep that is already active is deactivated and a warning is issued. If an instrument or function which contains a sweep is activated while another sweep is already active, the new sweep is deactivated and an appropriate warning is issued.

When a sweep is activated, the measurement system first continues to run in continuous or single-measurement mode; the sweep system does not assume control of the measurement system until the sweep is started.

When the active sweep is deactivated, the measurement system switches back to continuous measurement.

5.20.3 States of the Sweep System

The state of the sweep system is indicated above the 8th softkey.

Two-channel analyzer

Multichannel analyzer

Table 5-3: The following states are possible:

Off	Sweep is deactivated; the measurement system is controlled directly by the user.
Single	Single sweep is being performed
Cont	Continuous sweep is being performed
Waiting	Sweep is waiting for a (re)start; has been reactivated or has been run at least once as a single sweep.
Stopped	Sweep has been stopped; can be continued or restarted.

5.20.3.1 Continuous sweep

Continuous sweeps are started with START . The sweep state is indicated by "Sweep Cont ". When the sweep reaches the stop value of the x-axis or the end of the X sweep list, it starts again at the start value. This is repeated until one of the following events occurs:

START
Pressing START
- interrupts the currently running sweep at once
- deletes the sweep curves (in multiscan mode all scans are deleted) including the min/max curves
- resets the Min/Max. data and the limit violations of the sweep curves
- causes the continuous sweep to restart

Remote command:
`INITiate:CONTinuous` on page 700 `ON`
`INITiate:FORCe` on page 702 `STARt`

SINGLE
Pressing SINGLE switches to single sweep. The remaining points are plotted on the trace and the sweep system then enters the "Sweep Waiting" state.

Reactivation of continuous sweep with START ;

Remote command:
`INITiate:CONTinuous` on page 700 `OFF`
`INITiate:FORCe` on page 702 `SINGle`

STOP/CONT
Pressing STOP/CONT terminates the current measurement and pauses the sweep system (Sweep Stopped state).

Reactivation of continuous sweep either with START (starts from the beginning) or by pressing STOP/CONT again (resumes the sweep from the point where it was stopped).

Remote command:
`INITiate:FORCe` on page 702 `STOP`

Termination event
… stops the current sweep immediately and causes the continuous sweep to be restarted (see chapter 5.20.1, "Overview of Sweep Options", on page 339).

Z stop value reached
The continuous sweep is stopped; the sweep system changes to the "Sweep Waiting" state (only with 2-dimensional generator sweeps, see chapter 5.9.3, "Two-Dimensional Sweep", on page 275).

5.20.3.2 Single sweep

Single sweeps are started by pressing the SINGLE key and are performed once only. When the stop value (of the x-axis) has been reached, the sweep system switches to the "Sweep Waiting" state. With a 2-dimensional sweep, every new Z point (and the associated sweep over the x-axis) must therefore be retriggered.

The sweep state is indicated by "Sweep Single ".

A current single sweep is interrupted or terminated by the following events:

START
Pressing START
- interrupts the currently running sweep at once
- deletes the sweep curves (in multiscan mode all scans are deleted) including the min/max curves
- resets the Min/Max. data and the limit violations of the sweep curves
- starts a continuous sweep

Remote command:
`INITiate:CONTinuous` on page 700 `ON`
`INITiate:FORCe` on page 702 `STARt`

SINGLE
Pressing SINGLE stops the current sweep immediately and causes the single sweep to be restarted.

Remote command:
`INITiate:CONTinuous` on page 700 `OFF`
`INITiate:FORCe` on page 702 `SINGle`

STOP/CONT
Pressing STOP/CONT terminates the current measurement and pauses the sweep system (Sweep Stopped state).

The single sweep is reactivated either using SINGLE (sweep starts from the beginning) or by pressing STOP/CONT again (sweep continues from the point at which it was stopped).

Remote command:
`INITiate:FORCe` on page 702 `STOP`

Termination event
… stops the current sweep immediately and causes the single sweep to be restarted (see chapter 5.20.1, "Overview of Sweep Options", on page 339).

X stop value reached
The single sweep is stopped; the sweep system changes to the "Sweep Waiting" state.

Remote command:
-

5.20.3.3 Terminated sweep

The sweep system only enters this state if a single sweep or a 2-dimensional continuous sweep is terminated. No further measurements are performed; the measured values, data sets and sweep traces are frozen. Sweep traces should only be read out via the remote-control station when the system is in this state.

The sweep state is indicated by "Sweep Waiting ".

A terminated single sweep is affected by the following events:

START
Pressing START
- deletes the sweep curves (in multiscan mode all scans are deleted) including the min/max curves
- resets the Min/Max. data and the limit violations of the sweep curves
- starts a continuous sweep

Remote command:
`INITiate:CONTinuous` on page 700 `ON`
`INITiate:FORCe` on page 702 `STARt`

SINGLE
Pressing SINGLE causes the single sweep to be restarted.

Remote command:
`INITiate:CONTinuous` on page 700 `ON`
`INITiate:FORCe` on page 702 `SINGle`

STOP/CONT
Pressing STOP/CONT starts continuous measurement. Reactivating the single sweep with SINGLE .

Remote command:
-

Termination event
… starts the continuous measurement (see chapter 5.20.1, "Overview of Sweep Options", on page 339).

5.20.3.4 Stopped sweep

The measurement system only assumes this state when the STOP/CONT key is pressed while a measurement is being performed. Valid measured values and data sets from the sweep point last set are available. However, only some of the measured values of the sweep trace are available. Sweep traces should not be read out via the remote-control station when the system is in this state.

The sweep state is indicated by "Sweep Stopped"; **none of the LEDs** light up.

A stopped sweep is affected by the following events:

START
Pressing START
- deletes the sweep curves (in multiscan mode all scans are deleted) including the min/max curves
- resets the Min/Max. data and the limit violations of the sweep curves
- starts a continuous sweep

Remote command:
`INITiate:CONTinuous` on page 700 `ON`
`INITiate:FORCe` on page 702 `STARt`

SINGLE
Pressing SINGLE causes the single sweep to be restarted.

Remote command:
`INITiate:CONTinuous` on page 700 `OFF`
`INITiate:FORCe` on page 702 `SINGle`

STOP/CONT
Pressing STOP/CONT continues the sweep.

Remote command:
-

Termination event
… starts the continuous measurement (see chapter 5.20.1, "Overview of Sweep Options", on page 339).

5.20.4 Several Sweep Traces in One Diagram

Up to 2 traces can be displayed in every sweep window. There are two options for displaying the sweep traces. These options can be selected in the individual sweep windows:

- Each new sweep cycle deletes the old trace; only one trace (or trace pair) is visible at any one time (single-scan mode).

- Each new sweep cycle plots a new trace without deleting the old trace; all recorded traces are visible (multi-scan mode).

Since only a finite number of traces (i.e. the last 20 traces) can be stored in multi-scan mode, all the traces only remain visible until rescaling is performed. When rescaling is performed, the graphical display is deleted and the most recent traces are replotted making the graph easier to read. The number of traces to be replotted can be set in the "History" entry field.

5.21 Level Measurements

The R&S UPP provides various level measurements which can be used to determine the AC or DC voltage component of a measurement signal using various methods.

- "RMS" determines the RMS of any given signal using a broadband analysis, optionally with suppression of a DC component contained in the signal.
- "RMS Selective" determines the RMS of a specific frequency inside or outside a selectable frequency band (by using a bandpass filter or a bandstop filter). Once again, it is possible to suppress a DC component contained in the signal.
- Level Monitor in the DC setting determines the DC component of any signal.
- "Peak" determines the peak value of any given signal, the measured value changes with the peak value without a delay.

The voltage of an analog signal is determined in volts and the amplitude of a digital signal is determined in FS. According to AES-17, a full-scale digital sine-wave signal has a peak value and an RMS of 1.0 FS, i.e. in contrast to the analog signal, the RMS determined for a digital signal is higher by a factor of √2.

Level measurement is also possible using the FFT analysis by means of integration via the frequency lines. If the FFT measurement function is selected, the RMS value calculated by this method is shown as a function measured value, and the measurement bandwidth can be restricted using the parameter fields "Freq Limit ", followed by "Freq Lim Low " and "Freq Lim Upp ".

The interval during which the level of the measurement signal is monitored can be specified by the user as the measurement time or the interval time.

Other digital filters - besides the input filter - can also be looped into the measurement path for AC measurements.

5.21.1 Filter Settings

DC Suppress
Used to activate DC suppression (only with RMS measurements in the digital analyzer).

With the level measurements "RMS" and "RMS Selective", the user can decide whether DC levels are to be taken into consideration or suppressed in the RMS.

This parameter field is not available in the analog analyzer because the suppression function is already provided by the AC coupling, which can be set up using the hardware.

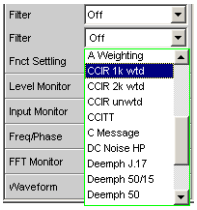
"deactivated" DC suppression deactivated.
The DC component of the measurement signal is not suppressed ("DC coupling") and is included in the measurement result.

"activated" DC suppression activated.
The DC component of the measurement signal is suppressed ("AC coupling"); the measurement result includes the AC component only. For DC suppression in the digital analyzer, the DC level is measured and subtracted from the total RMS value.

Remote command:
`SENSe<n1>:FUNCtion:DCSuppression` on page 725

Filter
Activating a digital filter in the test channel. Depending on the level measurement method selected, up to 2 user-defined filters or weighting filters can be looped into the measurement path:

- RMS, Peak, FFT: max. 2 filters
- RMS Selective: max. 1 filter in addition to selection filter
- DC: no filter



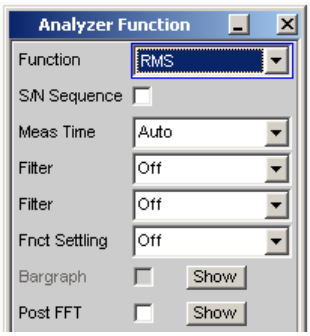
The user-definable filters are configured as filters 01 to 09 in the filter panel (see chapter 5.37, "User-Definable Filters", on page 446) and can then be used (repeatedly if necessary) in the analyzer.

For more information on the available weighting filters, see chapter 5.38, "Weighting Filters", on page 454.

Note: Regardless of the digital filters selected here, a further input filter ("prefilter") can be looped into the test channel. Moreover, the analog bandwidth can be restricted with the aid of the "Bandwidth" parameter field, which corresponds to an additional lowpass filter.

Remote command:
`SENSe<n1>:FILTer<n2>` on page 737
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

5.21.2 RMS Measurement, Broadband



Method used to measure the RMS of an AC voltage, either taking account of or disregarding a superimposed DC voltage. Any given signal shape can be measured.

Analog operation:

Depending on the selected coupling, a superimposed DC component is measured (DC coupling) or suppressed (AC coupling).

For more settings, see chapter 5.21, "Level Measurements", on page 345.

Digital operation:

The true RMS value of the signal content is displayed as a full-scale value from 0.0 to 1.0. Depending on whether "DC Suppress" is activated or deactivated, a superimposed DC component is measured (deactivated) or suppressed (activated).

SCPI command:

SENSe<n1>:FUNCtion `RMS`

Meas Time
This is used for choosing the measurement time for the purpose of adapting the measurement speed to the waveform or, in the case of single tone signals, to the signal frequency.

The priority can be set to a short measurement time or high accuracy depending on specific measurement requirements.

In automatic measurement modes the measurement time is adapted to the measured signal frequency, provided an AC signal that is sufficiently strong and not too low in frequency is present (f ≥ 10 Hz).

Note: With severely noise-corrupted or distorted signals and multi-tone signals, the automatic measurement modes (especially "Auto Fast") may no longer be able to clearly detect the signal period. To prevent measurement errors, such signals should therefore be measured using "Gen Track" or (if an external generator is used) using the "Value" measurement mode.

"Auto Fast" Where possible, the RMS measurement is performed over entire AC periods; with high frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed 1 %.
With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 100 ms (corresponding to 1 period at 10 Hz).

Recommended for single-tone measurements using an unknown external signal source if maximum measurement speed is desired.

Note: For infrasound measurements (below 10 Hz), can only be measured using a fixed measurement time (Value or Gen Track).

"Auto" Where possible, the RMS measurement is performed over entire AC periods; with medium or high frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **0.05 %**.
With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 200 ms (corresponding to 2 periods at 10 Hz).

Recommended for single-tone measurements using an unknown external signal source if maximum measurement accuracy is desired.

Note: For infrasound measurements (below 10 Hz), can only be measured using a fixed measurement time (Value or Gen Track).

"Value " The RMS measurement is performed over a preset time which must be entered in the parameter field below.

To prevent errors due to termination of measurements, the selected measurement time should be an integer multiple of the period. If the frequency of the signal to be measured is unknown or not constant, the selected measurement time should be as long as possible in order to minimize such errors.

Recommended for

- AC measurements of a known external signal source
- measurements of severely noise-corrupted or distorted signals of unknown frequency
- measurements of noise signals or multi-tone signals

"Gen Track" The RMS measurement is performed over (at least) 1 whole period of the generator signal; to allow this, the generator frequency is adapted to the sampling rate of the analyzer, if necessary. In the case of high frequencies, the measurement time is extended to several periods in order to increase the measurement accuracy.

Recommended for all AC measurements when using the R&S UPP Universal Generator; also particularly suitable for measuring severely noise-corrupted or distorted signals, and for fast sweeps.

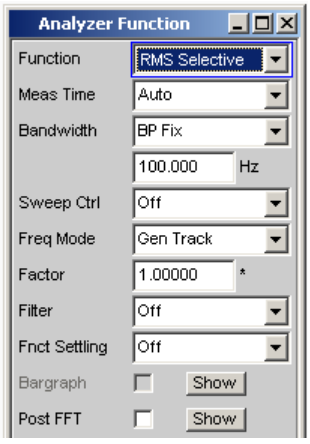
Note: If the "Mod Dist" signal is used as the generator signal, the measurement time is based on the (usually dominant) "Lower Frequency".

Note: If "Stereo Sine" is used as the generator signal, measurement channel 1 tracks generator channel 1, and measurement channel 2 tracks generator channel 2, in two-channel analyzer instruments.
In the case of multichannel analyzers, measurement channel 1 tracks generator channel 1 and measurement channels 2 ... 8 track generator channel 2.

Note: If "Arbitrary" is used as the generator signal, the measurement time is synchronized to the number of samples in the loaded file. As a result, measurement is always performed over a complete period of the (repeatedly output) ARB signal.

Remote command:
`SENSe<n1>:FUNCtion:APERture:MODE` on page 720
`SENSe<n1>:VOLTage:APERture` on page 721

5.21.3 RMS Measurement, Selective



Selective RMS measurement with narrow band bandpass filter or narrow band bandstop filter, either taking account of or disregarding a superimposed DC voltage.

In analog operation, depending on the coupling selected, a superimposed DC component is measured (DC coupling), or it is suppressed (AC coupling). In digital operation,

depending on whether "DC Suppress" is activated or deactivated, a superimposed DC component is measured (deactivated) or suppressed (activated).

If a bandpass filter is used, the desired frequency component is measured; if a band-stop filter is used, this component is suppressed. Any given signal shape can be measured.

For more settings, see chapter 5.21, "Level Measurements", on page 345.

SCPI command:

SENSe[1]:FUNCtion `RMSSelect`

Meas Time
This is used for choosing the measurement time for the purpose of adapting the measurement speed to the waveform or, in the case of single tone signals, to the signal frequency.

The priority can be set to a short measurement time or high accuracy depending on specific measurement requirements.

In automatic measurement modes the measurement time is adapted to the measured signal frequency, provided an AC signal that is sufficiently strong and not too low in frequency is present (f ≥ 10 Hz).

Note: With severely noise-corrupted or distorted signals and multi-tone signals, the automatic measurement modes (especially "Auto Fast") may no longer be able to clearly detect the signal period. To prevent measurement errors, such signals should therefore be measured using "Gen Track" or (if an external generator is used) using the "Value" measurement mode.

"Auto Fast" Where possible, the RMS measurement is performed over entire AC periods; with high frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed 1 %.
With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 100 ms (corresponding to 1 period at 10 Hz).

Recommended for single-tone measurements using an unknown external signal source if maximum measurement speed is desired.

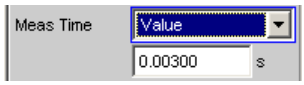
Note: For infrasound measurements (below 10 Hz), can only be measured using a fixed measurement time (Value or Gen Track).

"Auto" Where possible, the RMS measurement is performed over entire AC periods; with medium or high frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **0.05** %.
With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 200 ms (corresponding to 2 periods at 10 Hz).

Recommended for single-tone measurements using an unknown external signal source if maximum measurement accuracy is desired.

Note: For infrasound measurements (below 10 Hz), can only be measured using a fixed measurement time (Value or Gen Track).

"Value " The RMS measurement is performed over a preset time which must be entered in the parameter field below.



To prevent errors due to termination of measurements, the selected measurement time should be an integer multiple of the period. If the frequency of the signal to be measured is unknown or not constant, the selected measurement time should be as long as possible in order to minimize such errors.

Recommended for

- AC measurements of a known external signal source
- measurements of severely noise-corrupted or distorted signals of unknown frequency
- measurements of noise signals or multi-tone signals

"Gen Track" The RMS measurement is performed over (at least) 1 whole period of the generator signal; to allow this, the generator frequency is adapted to the sampling rate of the analyzer, if necessary. In the case of high frequencies, the measurement time is extended to several periods in order to increase the measurement accuracy.

Recommended for all AC measurements when using the R&S UPP Universal Generator; also particularly suitable for measuring severely noise-corrupted or distorted signals, and for fast sweeps.

Note: If the "Mod Dist" signal is used as the generator signal, the measurement time is based on the (usually dominant) "Lower Frequency".

Note: If "Stereo Sine" is used as the generator signal, measurement channel 1 tracks generator channel 1, and measurement channel 2 tracks generator channel 2, in two-channel analyzer instruments.
In the case of multichannel analyzers, measurement channel 1 tracks generator channel 1 and measurement channels 2 ... 8 track generator channel 2.

Note: If "Arbitrary" is used as the generator signal, the measurement time is synchronized to the number of samples in the loaded file. As a result, measurement is always performed over a complete period of the (repeatedly output) ARB signal.

Remote command:
`SENSe<n1>:FUNCtion:APERture:MODE` on page 720
`SENSe<n1>:VOLTage:APERture` on page 721

Bandwidth
Used to select the bandwidth and filter type (bandpass filter BP… or bandstop filter BS…).

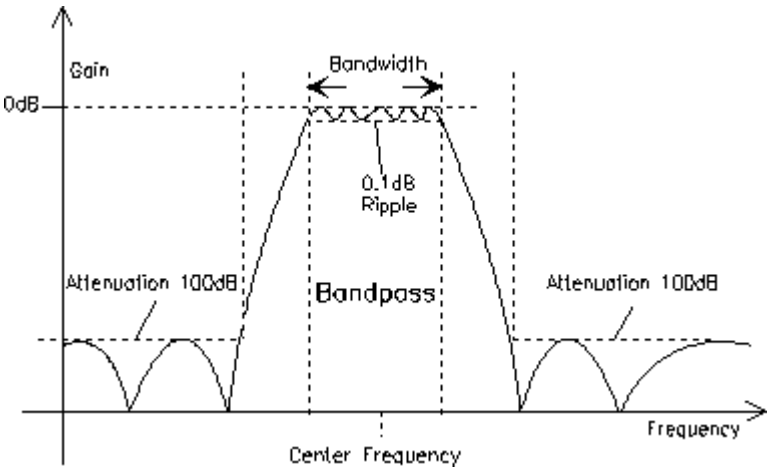


Fig. 5-8: Filter characteristic of an RMS Selective bandpass filter

"BP 1 % ""BS 1 %"

Bandpass filter / bandstop filter with relative width of 1 % (geometrically symmetrical about the center frequency).

(Bandpass filter)

(Bandstop filter)

"BP 3 % ""BS 3 % "

Bandpass filter / bandstop filter with relative width of 3 % (geometrically symmetrical about the center frequency).

(Bandpass filter)

(Bandstop filter)

"BP 1/12 Oct""BS 1/12 Oct"

Bandpass filter / bandstop filter with the relative width of one twelfth octave (geometrically symmetrical around the center frequency).

(Bandpass filter)

(Bandstop filter)
The relative bandwidth of one twelfth octave is ≈ 6 %.
It is calculated from

$$\sqrt[24]{2} - \left(1/\sqrt[24]{2}\right) = 0.0577 = 5.77\%$$

"BP 1/3 Oct""BS 1/3 Oct"

Bandpass filter / bandstop filter with the relative width of one third octave (geometrically symmetrical around the center frequency).

(Bandpass filter)

(Bandstop filter)
The relative bandwidth of one third octave is ≈ 23 %.
It is calculated from

$$\sqrt[6]{2} - \left(1/\sqrt[6]{2}\right) = 0.2315 = 23.15\%$$

Note: With the third-octave filter, the 0.1 dB bandwidth is reduced until an attenuation of approx. 3 dB is obtained for the cutoff frequencies. The effective bandwidth is therefore smaller than the precise bandwidth determined by calculation.

"BP 1/3 Oct Fast""BS 1/3 Oct Fast"

Very fast settling third-octave filter (see above) with only 40 % attenuation.

(Bandpass filter)

(Bandstop filter)

"BP Fix""BS Fix"

Bandpass filter / bandstop filter with selectable, arithmetically symmetrical bandwidth which must be entered in the parameter field below.

(Bandpass filter)

(Bandstop filter)

Note: For infrasound measurements, the bandwidth can be reduced down to a sampling rate/48000 (but at least 1 Hz). As very long filter settling times occur in the range below 10 Hz, measurement results can only be viewed after several seconds.

Remote command:

`SENSe<n1>:BANDwidth:MODE` on page 722

`SENSe<n1>:BANDwidth` on page 722

Sweep Ctrl

Used to activate and configure or deactivate the bandpass sweep / bandstop sweep in the analyzer sweep system.

Note: The sweeps are also deactivated implicitly when the generator sweep is activated and when certain start conditions are selected (e.g. external sweeps or "Time Chart").

"Off" The bandpass sweep / bandstop sweep is deactivated; the band center frequency can be specified in the "Freq Mode" parameter field.
If the generator sweep system is also deactivated, START , SINGLE and STOP/CONT affect the measurement system:

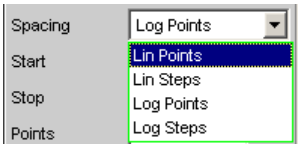
- START starts a continuous measurement,
- SINGLE starts a single measurement or continues an already started continuous measurement as a single measurement.
- STOP/CONT interrupts an ongoing measurement or continues an interrupted or terminated measurement as a continuous measurement.

"Auto Sweep" The bandpass sweep / bandstop sweep is activated; the sweep stepping is performed automatically; the sweep axis is calculated from the start value, stop value and step size or point number.

"Auto List" The bandpass sweep / bandstop sweep is activated; the sweep stepping is performed automatically; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file).

Remote command:
`SENSe<n1>:SWEep:CONTrol` on page 723

Spacing
Used to select the sweep range spacing, i.e. the way in which the sweep points are distributed on the sweep axis. Only visible for activated bandpass / bandstop sweep.



"Lin Points" The sweep range is divided linearly by specifying a number of points (linear sweep). This number is entered in the "Points" parameter field. Should be selected if equidistant, linear spacing of all points is required.

"Lin Steps" The sweep range is divided into intervals of a specified linear step size starting at "Start" (linear sweep). This step size is entered in the "Step" parameter field.

"Log Points" The sweep range is divided logarithmically by specifying a number of points (logarithmic sweep). This number is entered in the "Points" parameter field.
Should be selected if equidistant, logarithmic spacing of all points is required.

"Log Steps" The sweep range is divided into intervals of a specified logarithmic step size starting at "Start" (logarithmic sweep). Each sweep point is calculated by multiplying the previous point by a constant factor. This factor is entered in the "Step" parameter field.

Remote command:
`SENSe<n1>:SWEep:SPACing` on page 723

Start
Used to enter the start value for the bandpass / bandstop center frequency. Only visible for activated bandpass / bandstop sweep.

The start and stop value implicitly determine the sweep direction:

If the start value is less than the stop value, an upward sweep is performed, otherwise a downward sweep will be performed.

If a start value identical to the stop value is entered, the stop value is automatically loaded with the old start value. In this way, it is possible to change the sweep direction by entering just one value.

Remote command:
`SENSe<n1>:SWEep:STARt` on page 723

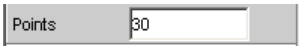
Stop
Used to enter the stop value for the bandpass / bandstop center frequency. Only visible for activated bandpass / bandstop sweep.

The start and stop value implicitly determine the sweep direction:

If a stop value identical to the start value is entered, the start value is automatically loaded with the old stop value.

Remote command:
`SENSe<n1>:SWEep:STOP` on page 724

Points
Used to enter the number of sweep points for the bandpass / bandstop center frequency. Only visible for activated bandpass / bandstop sweep if "Lin Points" or "Log Points" is set for "Spacing".



The sweep range is divided into "Points – 1" (linear or logarithmic) equidistant steps. At least 2 points (start and stop value) are required.

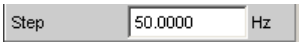
A maximum of 1024 points can be selected.

Remote command:
`SENSe<n1>:SWEep:POINts` on page 723

Step
Used to enter the (linear or logarithmic) step size for the bandpass / bandstop center frequency. Only visible for activated bandpass / bandstop sweep if "Lin Steps" or "Log Steps" is set for "Spacing".

The entry range is limited automatically so that at least one and at most 1023 steps exist (corresponding to 1024 sweep points).

With linear step, the size of the step must always be entered, i.e. the numeric value is positive even if the start value is greater than the stop value. The physical unit is the same as that used when specifying "Start" and "Stop".



(Example for lin. frequency sweep)

With logarithmic step, the factor must be entered by which each sweep point is to be multiplied in order to move to the next sweep point. Swapping the start and stop value (reversal of the sweep direction) therefore produces the reciprocal value. The closer the numeric value is to 1.0, the more sweep steps will be performed.

(Example for log. upward sweep)

Note: Since the last step of the sweep is automatically adapted such that it corresponds exactly to the stop value, it may deviate by max. 50% from the selected step size. If this is to be avoided, either the start / stop value must be corrected accordingly or the sweep spacing must be set using the "Points" parameter.

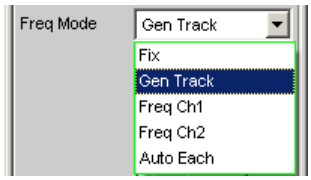
Remote command:
`SENSe<n1>:SWEep:STEP` on page 723

File Name
Entry of the file name for the list of bandpass/bandstop center frequencies (frequency sweep list). Only visible if bandpass / bandstop list sweep is activated.

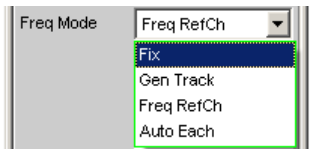
Remote command:
`MMEMory:LOAD:FREQuency:SLCFrequency` on page 722

Freq Mode
Used to determine the bandpass / bandstop center frequency.

Two-channel analyzer:



Multichannel analyzer:



"Fix" Fixed bandpass / bandstop center frequency. The center frequency must be entered in the parameter field below.

Note: For infrasound measurements, the center frequency can be reduced down to a sampling rate/48000 (but at least 1 Hz). As very long filter settling times occur in the range below 10 Hz, measurement results can only be viewed after several seconds.

"Gen Track" The bandpass / bandstop center frequency tracks the generator (nominal) frequency. This can be changed by means of manual entry in the Generator Function panel or owing to a generator frequency sweep. If the internal stereo generator is used, on two-channel analyzers measurement channel 1 tracks generator channel 1 and measurement channel 2 tracks generator channel 2. On multichannel analyzers, measurement channel 1 tracks generator channel 1 and measurement channels 2 ... 8 track generator channel 2.
By entering a factor in the next parameter field, the user can select whether the center frequency is to be identical to the generator frequency (factor = 1) or a multiple of the generator frequency. Setting a whole number for this factor will allow individual harmonics to be measured.
An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or noise signal).
Recommended for use with the internal R&S UPP Universal Generator.

"Freq Ch1" The bandpass/bandstop center frequency tracks the frequency measured in channel 1; not selectable in the multichannel analyzers.
Recommended for use with an external signal source.

"Freq Ch2" The bandpass/bandstop center frequency tracks the frequency measured in channel 2; not selectable in the multichannel analyzers.
Recommended for use with an external signal source.

"Auto Each" The bandpass / bandstop center frequency of each channel tracks the frequency measured in the respective channel.
If one of the channels does not provide unambiguous frequency information - e.g. in the case of multitone or noise signals, or if there is no input signal - the measurement for this channel is marked as invalid. This does not have any negative impact on the measured value for the other (valid) channel, but the measurement time is considerably longer. In these cases, it is therefore advisable to use the appropriate mode for each situation: "Freq Ch1" or "Freq Ch2" for the two-channel analyzers, and "Freq RefCh" mode for multichannel analyzers. This is to be recommended when using an external stereo signal source.

"Freq Ref Ch" The bandpass/bandstop center frequency tracks the frequency measured in the reference channel; only available in the multichannel analyzers.
Recommended for use with an external signal source.

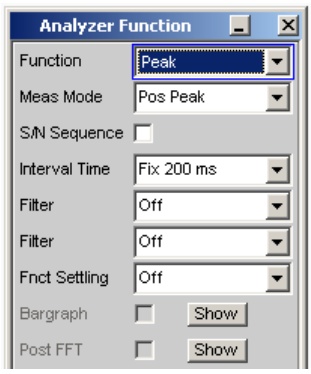
Remote command:
SENSe<n1>:FREQuency:SELect on page 723
SENSe<n1>:FREQuency on page 722

Factor
Used to enter the factor by which the center frequency of the bandpass filter or bandstop filter is to be higher than the generator frequency. Only visible in "Freq Mode Gen Track".

Setting an integer factor greater than 1 will therefore allow an individual harmonic to be measured. If the fundamental is to be selected, the factor must be set to 1.

Remote command:
SENSe<n1>:FREQuency:FACTor on page 723

5.21.4 Peak Measurement



Measurement of the peak value of any given signal, and the rise and fall of the measured value all occur without a delay. The measured value contains both AC and DC components.

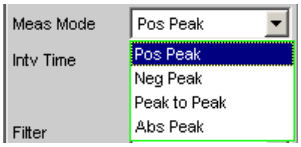
SCPI command:

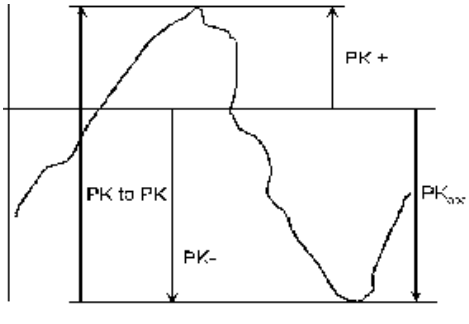
SENSe[1]:FUNCtion PEAK

If a square wave is applied, it is limited with respect to bandwidth by the upper measurement limit of the selected analyzer, and overshoots occur at the edges (Gibbs phenomenon). The overshoots are also measured during the peak analysis, which means that the returned measured value may be greater than the input peak. FS values greater than 1 may be measured, especially in the digital range.

For more settings, see chapter 5.21, "Level Measurements", on page 345.

Meas Mode
Used to select the measurement mode.





Result of Peak measurement on 2 example signals depending on selected measurement mode

"Pos Peak" The highest positive voltage value is measured.

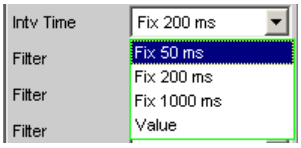
"Neg Peak" The (numerically) highest negative voltage value is measured.

"Peak to Peak" The difference between the highest and lowest level is measured (peak-to-peak voltage).

"Abs Peak" The numerically highest (positive or negative) voltage value is measured.

Remote command:
`SENSe<n1>:FUNCtion:MMODe` on page 721

Intv Time
Used to select the measurement interval within which the peak search is to be performed. When the interval time has expired, the peak value memory is reset and the next peak value is sought.



"Fix 50 ms" Measurement interval 50 ms.

"Fix 20 ms" Measurement interval 200 ms.

"Fix 1000 ms" Measurement interval 1000 ms.

"Value " The interval time is entered in the parameter field below.

Remote command:
SENSe<n1>:VOLTage:INTVtime:MODE on page 724
SENSe<n1>:VOLTage:INTVtime on page 724

5.21.5 DC voltage measurement

Measurement of the DC voltage component of an analog or digital signal. The "DC measurement" is not a separate measurement function, but a measurement method that can be selected under "Level Monitor"). This makes it possible to perform any other desired measurement function at the same time as a DC level measurement, see "Level Monitor" on page 434

The level is acquired at the Monitor level, i.e. after the prefilter.

The measurement is performed using zero-crossing detection to eliminate the level component of any superimposed periodic AC signal that may be present. As a result, the measurement time is not constant, but instead is an integer multiple of the period of the superimposed AC signal.

In the case of very weak signals or signals with no AC component, the upper measurement time limit is 100 ms.

If "DC" is selected as a measurement function, a reference to the Level Monitor is shown and the previously configured measurement function is maintained.

Remote control command:

SENSe6:FUNCtion DC

5.22 Signal-to-Noise Measurements

The R&S UPP provides signal-to-noise measurements ("", "S/N measurements") according to a number of different weighting methods. Each of these measurement functions measures the level with and without a signal: For measurement of the signal the set generator signal is output; for noise measurement the generator signal is turned off and the noise level of the DUT is measured. The measured signal-to-noise ratio is displayed as the measurement result.

The S/N sequence consists of two complete level measurement cycles that are performed and displayed independently of one another.

- The measured values for level monitor, input monitor, post FFT and waveform are displayed for signal measurement first, and then for noise measurement.
- The frequency and phase are measured only during signal measurement. The measured values remain unchanged during noise measurement.

- The result of the function can be determined only at the end of noise measurement. In continuous measurement mode the display shows the latest valid result or "---" during signal measurement.

For signal-to-noise measurements, the internal Universal Generator must be used, since an external generator cannot be controlled by the measurement function. If the DUT is inadvertently not connected to the internal generator, measured values of around 0 dB would be determined.

The signal for noise measurement is generated by an analog or digital generator depending on the DUT:

- In the case of an analog generator instrument, the generator output voltage is switched off and the output impedance remains unchanged.
- In the case of digital generator instruments, a level value of 0.0 fullscale is output with an unchanged clock rate (all bits on 0).

If the analog universal generator is used, care must be taken to ensure that the correct Volt Range is selected on the Generator Config Panel (see chapter 5.2.1, "Analog Generator Config Panel", on page 186). In Auto mode the analog gain is canceled during noise measurement, which on the one hand brings about an improvement in the inherent noise (and therefore in the S/N dynamic response), but on the other hand results in a longer measurement time.

The level weighting method can be chosen from the following:

- RMS: Root-mean-square broadband measurement
- Peak: Peak-value measurement.

When the analog analyzer is used, switching off the generator causes a DC jump at the analyzer input, and this must not be allowed to affect the highly sensitive noise measurement.

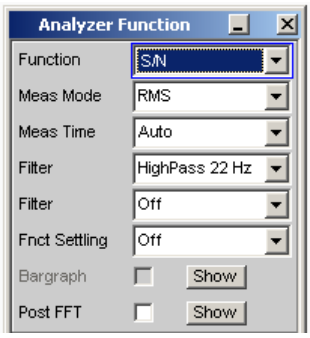
There are two measures which will solve this problem:

- The S/N measurement should preferably be carried out using a low-frequency highpass or comparable weighting filter. Failing to use a suitable filter will result in an error message.
- For measurement at low frequencies, where a highpass filter cannot be used, the recommended alternative is a file-defined delay filter with around 1.5 s of delay. This allows the DC jump to decay before the noise measurement starts.

S/N measurement can be performed via the S/N measurement function. This measurement function is found at menu item "Meas Mode" and offers a choice of level weighting methods.

Conversely – as with the previous products, R&S UPD, R&S UPL and R&S UPV – the S/N sequence can also be activated during level measurements. This alternative operating mode ensures compatibility with the earlier models mentioned, and in particular enables remote-control programs to be used unchanged.

5.22.1 S/N Measurement Function

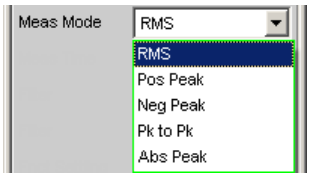


Measurement function for determining the signal to noise of a DUT.

SCPI command:SENSe[1]:FUNCtion SN

For more settings, see chapter 5.21, "Level Measurements", on page 345.

Meas Mode
Used for choosing the level weighting method for signal and noise measurement.



"RMS" Both level measurements are carried out in the form of broadband RMS measurements.

"Pos Peak" Both level measurements are carried out in the form of peak value measurements of the highest positive level.

"Neg Peak" Both the level measurements are carried out in the form of peak value measurements of the highest negative level

"Pk to Pk" Both level measurements are carried out in the form of peak to peak measurements

"Abs Peak" Both the level measurements are carried out in the form of peak value measurements of the absolute magnitude of the highest level.

Remote command:
SENSe<n1>:FUNCtion:MMODe on page 721

DC Suppress
Used to activate DC suppression (in the digital analyzer only).

You can decide whether any DC level which may be present in the RMS value should be taken into account or suppressed.

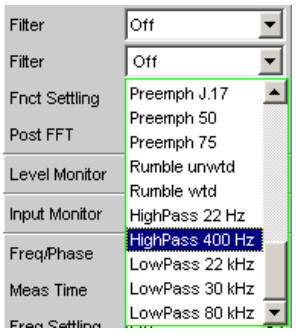
This parameter field is not available in the analog analyzer because the suppression function is already provided by the AC coupling which can be set up using the hardware.

"deactivated" DC suppression deactivated.
The DC component of the measurement signal is **not** suppressed ("DC coupling") and is included in the measurement result.

"activated" DC suppression activated.
The DC component of the measurement signal is suppressed ("AC coupling"); the measurement result includes the AC component only. For DC suppression in the digital analyzer, the DC level is measured and subtracted from the total RMS value.

Remote command:
`SENSe<n1>:FUNCtion:DCSuppression` on page 725

Filter
Activating a digital filter in the test channel. Up to 2 user-defined or weighting filters can be looped into the measurement path. At least one of the 2 filters in the analog analyzer should be a highpass or comparable weighting filter in order to filter out the DC jump when the generator is turned off. For this purpose, HighPass 22 Hz is activated in Filter #1 by default.



The user-definable filters are configured as filters 01 to 09 in the filter panel (see chapter 5.37, "User-Definable Filters", on page 446) and can then be used (repeatedly if necessary) in the analyzer.

For a description of selectable weighting filters, see chapter 5.38, "Weighting Filters", on page 454.

The filters chosen in this way work during noise measurement only. During signal measurement they are bypassed. This makes it possible to apply a deliberate weighting to the noise signal without affecting the other signal level.

Note: The input filter "prefilter" in the configuration part of the analyzer affects both signal measurement and noise measurement. Thus if there is a need for a filter that also filters the signal component, it can be chosen as a prefilter. Moreover the analog bandwidth can be restricted with the aid of the "Bandwidth" parameter field, which corresponds to an additional lowpass filter.

Remote command:
`SENSe<n1>:FILTer<n2>` on page 737
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Meas Time
This is used for choosing the measurement time for the purpose of adapting the measurement speed to the waveform or, in the case of single tone signals, to the signal frequency.

The priority can be set to a short measurement time or high accuracy depending on specific measurement requirements.

In automatic measurement modes the measurement time is adapted to the measured signal frequency, provided an AC signal that is sufficiently strong and not too low in frequency is present (f ≥ 10 Hz).

Note: With severely noise-corrupted or distorted signals and multi-tone signals, the automatic measurement modes (especially "Auto Fast") may no longer be able to clearly detect the signal period. For the avoidance of measurement errors, such signals should therefore preferably be measured using "Gen Track" or "Value".

"Auto Fast" For use with the RMS measurement mode only.
Level measurements are performed as far as possible over whole AC periods. In the case of high frequencies, the measurement time is extended so that a maximum algorithmic error of **1** % is not exceeded.
In the case of low-noise DUTs the upward measurement time for noise measurement is limited to 100 ms (corresponding to 1 period at 10 Hz).

This setting is recommended when the excitation (in signal measurements) is a single tone signal, if the aim is to achieve the highest measurement accuracy.

"Auto" For use with the RMS measurement mode only.
Level measurements are performed as far as possible over whole AC periods. In the case of medium or high frequencies, the measurement time is extended so that a maximum algorithmic error of **0.05** % is not exceeded.
In the case of low-noise DUTs, the upper measurement time is limited to 200 ms (corresponding to 2 periods at 10 Hz).

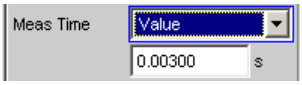
"Gen Track" For use with the RMS measurement mode only.
Level measurements are performed over at least 1 whole period of the generator signal. For this purpose the generator frequency is adapted as necessary to the sampling rate of the analyzer. In the case of high frequencies, the measurement time is extended to several periods in order to increase the measurement accuracy.

This setting is recommended when the excitation (in signal measurements) is a single tone signal.

Note: If "Stereo Sine" is used as the generator signal, measurement channel 1 tracks generator channel 1, and measurement channel 2 tracks generator channel 2, in two-channel analyzer instruments.
In the case of multichannel analyzers, measurement channel 1 tracks generator channel 1 and measurement channels 2 ... 8 track generator channel 2.

Note: If "Arbitrary" is used as the generator signal, the measurement time is synchronized to the number of samples in the loaded file. As a result, measurement is always performed over a complete period of the (repeatedly output) ARB signal.

"Value " Measurement is performed inside a predefined time which has to be entered in the following parameter field.



In order to **avoid** errors caused by the termination of measurements, the chosen measurement time should be an integer multiple of the period and, due to the noise measurement, should not be too short. This setting is recommended when the excitation (in signal measurements) consists of noise signals or multitone signals.

"Fix 50 ms" For use with peak measurement modes only
The measurement time is 50 ms.

"Fix 200 ms" For use with peak measurement modes only
The measurement time is 200 ms.

"Fix 1000 ms" For use with peak measurement modes only
The measurement time is 1000 ms.

Remote command:
`SENSe<n1>:FUNCtion:APERture:MODE` on page 720
`SENSe<n1>:VOLTage:APERture` on page 721

5.22.2 S/N Sequence in Level Measurements

In order to ensure compatibility with the previous models R&S UPD, R&S UPL and R&S UPV, the R&S UPP also has the capability of activating the S/N sequence in level measurements; as a result, particularly remote control programs can still be used without any modifications.

For more settings, see chapter 5.21, "Level Measurements", on page 345.

S/N Sequence
Used for activating the S/N sequence in order to determine the signal to noise.

Signal-to-noise measurement can thus be performed in the "RMS" and "Peak" level measurement modes.

"deactivated" The S/N sequence is disabled.
A pure level measurement is carried out.

"activated" The S/N sequence is enabled
Level measurement is performed with the generator signal switched on and then with it switched off. The S/N measurement result is determined from this.

Remote command:
`SENSe<n1>:FUNCtion:SNSequence` on page 725

5.23 Distortion Measurements

The R&S UPP provides various methods for measuring distortions. These methods can be used to determine harmonic or intermodulation distortions of a DUT.

The measurement signals required in each case can be generated by the internal generator (recommended) or by an external signal source.

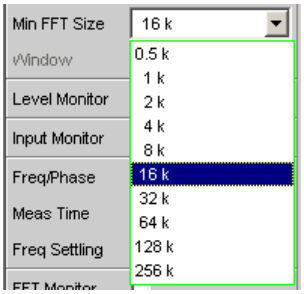
- **THD** (total harmonic distortion) is a distortion measurement over the first 8 harmonics or over any given combination of the first 8 harmonics. The noise between the harmonics is not measured. An ultra-pure sine-wave signal is required as the measurement signal.
- **THD+N & SINAD** (total harmonic distortion + noise) is a distortion measurement that measures the energy of the broadband noise **and** (optionally) of all harmonics within a selectable frequency band. An ultra-pure sine-wave signal is required as the measurement signal.
- **Mod Dist** is a modulation factor analysis that determines the total intermodulation factor of the 2nd **and** 3rd order of a low-frequency interfering signal to a high-frequency useful signal. The interfering signal should have the same or a higher amplitude than the useful signal (preferably an amplitude ratio of 4 : 1).
- **DFD** is a difference-tone factor analysis that determines the 2nd and 3rd order intermodulation products generated by two sine-wave signals of the same amplitude.

The individual distortion components can be assessed visually using the bar graph or (Post) FFT, see also chapter 5.26.3, "Post FFT", on page 398.

The measured values can only have the full dynamic range if both the signal source and the analyzer are at full-scale level. If the measured values are worse than expected, the following rules should be checked and observed.

- The **digital generator** should use all available audio bits; the (overall) signal should have a level of 1.0 FS and as little dither as possible.
- The **analog analyzer** should be operated in the optimum range, preferably in the "Auto" mode. If the "Fix" or "Lowest" mode is used, it is important to ensure that the selected range is not significantly higher than the applied total voltage.

The individual distortion components (harmonics or intermodulation products) and thus the distortion measured values are calculated using FFT. The FFT value is automatically adapted to the measurement signal. The longer the required FFT, the longer the necessary integration time and therefore the longer the total measurement time. You can choose the **minimum** FFT value when Post FFT is enabled:



By increasing the minimum FFT value you can increase the ratio of measurement accuracy to measurement speed loading, since the distortion components are then measured in a narrower band.

If the selected FFT value is not large enough to capture the measurement signal, increase the FFT gradually by a factor of 2.

The maximum FFT value depends on the bandwidth or sampling rate:

- at a 22 kHz bandwidth (analog) the FFT value can be increased to a maximum of 64 k,
- at sampling rates of less than 50 kHz (digital) or at a 40 kHz bandwidth (analog) the FFT value can be increased to a maximum of 128 k,
- at sampling rates of greater than 50 kHz (digital) or at an 80 kHz bandwidth (analog) the FFT value can be increased to a maximum of 256 k,

The maximum integration time in the analog analyzer (fast mode) is therefore around 1.4 s.

5.23.1 General Settings

This chapter contains the settings that occur in a number of distortion measurements where they have the same meaning.

Equalizer
Used for activating/deactivating a precorrector table for the FFT bins.

In this way, the frequency response of a transmission link can be precorrected, for example, and in so doing the measurement point is transformed into another reference point.

When precorrection is enabled, the computed FFT bins are multiplied by a frequency-dependent factor, after which they are used to calculate the distortion measurement and applied to the display.

The factor is determined by interpolation between the two adjacent frequency reference points in the precorrector table.

Precorrection of the FFT spectrum is an attractive alternative to filtering the input signal, since the precorrector file can simply be generated from the frequency response requiring precorrection and need not be in the form of a coefficient file or pole/zero file.

Application:

In acoustic measurements (e.g. with mobile telephones) on artificial ears of type 3.2 or higher, it is possible to compensate for the transfer function ERP (ear reference point) to DRP (drum reference point). Measurement of the sound waves by the microphone applied to the "eardrum" can thus be referred to the required measurement point (at the auricle).

Note: The precorrector table is created after acquiring or reading in the trace data from the DUT in the "DispConfig" panels.

"deactivated" The precorrector is disabled. The FFT bins are used and displayed without change. The measured value is calculated from the **original** FFT spectrum.

"activated" The precorrector is enabled. The next entry field, which is "Equal File", for the file name of the precorrector table, is activated and the file shown there is loaded. The measured value is calculated from the **precorrected** FFT spectrum.

Remote command:
`SENSe<n1>:VOLTage:EQUalize` on page 726
`MMEMory:LOAD:IEQualize` on page 725

Bargraph
Used for activating bargraph computation and display. In addition the "Bargraph1" window can be opened from here.

Configuration of the bargraphs is reserved for the "Bargraph1 Config" and/or "Bargraph2 Config" windows. The actual display takes place in the "Bargraph1" or "Bargraph2" windows.

Note: When measuring total harmonic distortion "(THD+N & SINAD)" there is no point in having a bargraph display, since the measurement does not involve discrete harmonics but rather the entire harmonic spectrum complete with noise. Therefore "Bargraph" is not available and the graph is not updated.

"deactivated" Bargraph computation (and update) disabled.
Recommended for increasing the measurement speed (e.g. for sweeps or remote control).

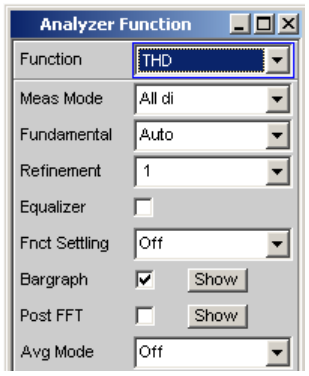
"activated" Bargraph computation (and update) enabled. The remaining settings dynamically define the associated measurement function.

Remote command:
SENSe<n1>:FUNCtion:BARGraph on page 726

Post FFT
Activation of the Post FFT; furthermore, the graphics window "FFT Graph1" can be opened from here.

For details, see chapter 5.26.3, "Post FFT", on page 398.

5.23.2 THD



THD (total harmonic distortion) is a measurement of distortion over the first 8 harmonics or over any combination of the first 8 harmonics (d2 to d9), wherein the amplitudes of the individual harmonics amplitudes are measured selectively. The root from the square sum of the harmonics can be displayed either as an RMS or as a ratio to the total RMS. Unlike with THD+N & SINAD measurement, the noise between the harmonics is **not** measured.

An ultra-pure sine-wave signal is required as the measurement signal. The selected frequency of this sine-wave signal should be such that the significant components of the distortion spectrum are still below the upper measurement limit.

If the first harmonic lies above the set IF bandwidth, an error message appears in the user info line and the measured value is identified as invalid (---).

The "sine" signal function of the internal generator is recommended as the **signal source**. The sine-wave level and frequency can be varied or swept.

SCPI command:

SENSe[1]:FUNCtion THD

For alternative distortion measurement, see chapter 5.23.3, "THD+N & SINAD", on page 375.

For more distortion measurements, see chapter 5.23, "Distortion Measurements", on page 367.

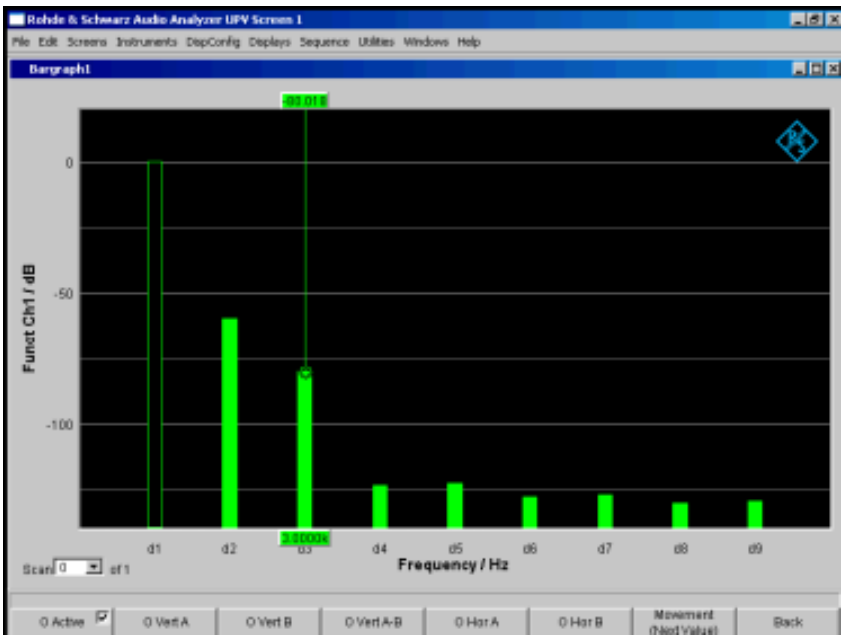
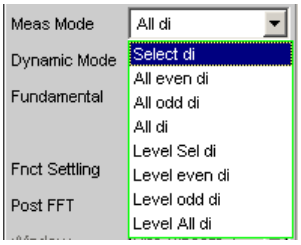


Fig. 5-9: THD measurement of a 1 kHz sine-wave signal with two harmonics of -60 dB and -80 dB

Meas Mode

Used to select the harmonics to be taken into consideration in the THD measured value and to select the calculation formula for the measured value.



Note: All 8 harmonics – and the fundamental – are always displayed in the graph irrespective of the selected measurement mode.

The term **Level** indicates that the measurement result is displayed as an RMS value and is **not** relative to the total RMS value (as is customary with distortion measurements).

"Select di" The distortion of any given combination of harmonics d2 to d9 (root from the square sum of the selected harmonics) is measured **relative** to the total RMS value.

$$U_{THD}[dB] = 20 \cdot \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + \ldots}}{TotalRMS}$$

The measured value can be displayed in % as well as in dB.

"All even di" The **distortion** of all **even** harmonics d2 to d8 (root from the quadratic sum of the even harmonics) is measured **relative** to the total RMS value.

$$U_{THD}[dB] = 20 \cdot \log \frac{\sqrt{U_{d2}^2 + U_{d4}^2 + U_{d6}^2 + U_{d8}^2}}{TotalRMS}$$

The measured value can be displayed in % as well as in dB.

"All odd di" The **distortion** of all **odd** harmonics d3 to d9 (root from the quadratic sum of the odd harmonics) is measured **relative** to the total RMS value.

$$U_{THD}[dB] = 20 \cdot \log \frac{\sqrt{U_{d3}^2 + U_{d5}^2 + U_{d7}^2 + U_{d9}^2}}{TotalRMS}$$

The measured value can be displayed in % as well as in dB.

"All di" The distortion of all harmonics d2 to d9 (root from the square sum of all 8 harmonics) is measured relative to the total RMS.

$$U_{THD}[dB] = 20 \cdot \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + ... + U_{d8}^2 + U_{d9}^2}}{TotalRMS}$$

The measured value can be displayed in % as well as in dB.

"Level Select di" The distortion voltage of any given combination of harmonics d2 to d9 (root from the square sum of the selected harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d3}^2 + ...}$$

The measured value is displayed in voltage units (volts or FS).
The desired harmonics are selected in the parameter fields below.

"Level even di" The distortion voltage of all even harmonics d2 to d8 (root from the square sum of the even harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d4}^2 + U_{d6}^2 + U_{d8}^2}$$

The measured value is displayed in voltage units (volts or FS).

"Level odd di" The distortion voltage of all odd harmonics d3 to d9 (root from the square sum of the even harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d3}^2 + U_{d5}^2 + U_{d7}^2 + U_{d9}^2}$$

The measured value is displayed in voltage units (volts or FS).

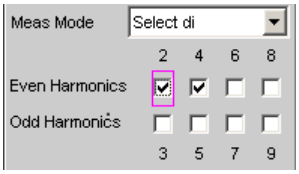
"Level all di" The distortion voltage of all harmonics d2 to d9 (root from the square sum of all 8 harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d3}^2 + ... + U_{d8}^2 + U_{d9}^2}$$

The measured value is displayed in voltage units (volts or FS).

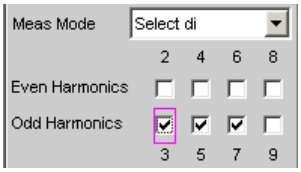
Remote command:
`SENSe<n1>:FUNCtion:MMODe` on page 721

Even Harmonics
Used to select the desired even harmonics; only available if "(Level) Select di" is selected under "Meas Mode".



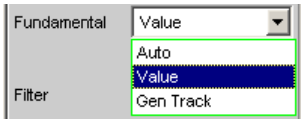
Remote command:
SENSe<n1>:FUNCtion:DISTortion<n3> on page 726
<n3> designates harmonics 2 to 9

Odd Harmonics
Used to select the desired odd harmonics; only available if "(Level) Select di" is selected under "Meas Mode".



Remote command:
SENSe<n1>:FUNCtion:DISTortion<n3> on page 726
<n3> designates harmonics 2 to 9

Fundamental
Used to determine the fundamental frequency.



"Auto" The fundamental frequency is determined (separately for each channel) by means of internal frequency measurement.
Recommended for use with an external signal source.

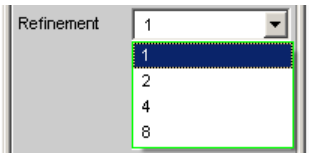
"Value " Fixed fundamental frequency; the value must be entered in the parameter field below.

Recommended for signals with a high noise component if an external generator is used as the signal source.

"Gen Track" The fundamental frequency changes with the generator (nominal) frequency. This can be changed by means of manual entry in the Generator Function panel or owing to a generator frequency sweep. Setting reliability in the case of signals with a high noise component is thus improved and measurement speed is increased.
An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or noise signal).
Recommended when using the internal universal generator.

Remote command:
`SENSe<n1>:VOLTage:FUNDamental:MODE` on page 727
`SENSe<n1>:VOLTage:FUNDamental` on page 727

Refinement
Improvement of the signal-to-noise ratio

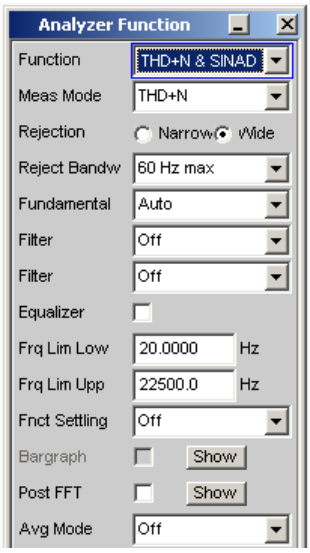


"1" The refinement factor 1 is suitable for the THD measurement on signals with good S/N ratio.

"2, 4, 8" With an adverse S/N ratio and low total harmonic distortion, the noise signal can receive a higher level than the distortion product in the analysis bandwidth, thereby leading to hardly any informative measurement results. With the refinement factors 2, 4 or 8, the analysis bandwidth is reduced accordingly, thereby increasing the frequency resolution, which leads to an improvement in the S/N ratio in increments of 3 dB each.

Remote command:
`SENSe<n1>:FUNCtion:REFNment` on page 726

5.23.3 THD+N & SINAD

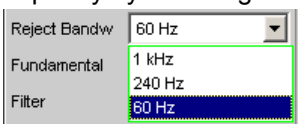


THD+N & SINAD (total harmonic distortion + noise) is a distortion measurement that measures and displays the energy of the broadband noise **without the fundamental** (residual signal) within a selectable frequency band (optionally, the energy can also be displayed relative to the total energy). This measurement function allows different measurement modes; it is also possible to eliminate the harmonics, except for the fundamental, so that the measured value only contains non-harmonic components and noise.

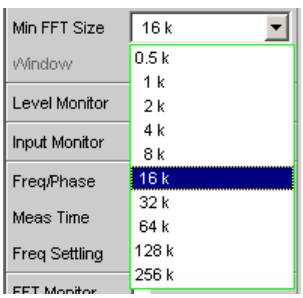
An FFT is used to record the spectrum, filter out the fundamental and calculate the total remaining energy (residual spectrum) – comprising of harmonics and broadband noise – within the band limits specified with "Frq Lim Low" and "Frq Lim Upp". The FFT value is automatically adapted to the measured fundamental frequency; the lower the frequency is, the longer the required FFT and, therefore, the integration time will be.

The user can select the **minimum FFT value**:

- implicitly by selecting the rejection bandwidth (with deactivated Post FFT)



- explicitly by selecting the minimum FFT length "Min FFT Size " with activated "Post FFT ".



Here a compromise must be made between measurement speed and measurement accuracy:

- A small (initial) FFT length and a large rejection bandwidth ("Rejection Bandwidth") mean a short measurement time; the filtered-out sideband of the fundamental is, however, relatively large. Non-harmonic signal components close to the fundamental are not measured.
- A large (initial) FFT length means a long sampling time; the filtered-out sideband of the fundamental is, however, relatively small so that signal components (non-harmonics and noise) close to the fundamental are also measured.

If the selected FFT value is not large enough to determine the fundamental of the measurement signal, the length of the FFT is increased gradually by a factor of 2.

The maximum FFT value depends on the bandwidth or sampling rate:

- at a 22 kHz bandwidth (analog) the FFT value can be increased to a maximum of 64 k,
- at sampling rates of less than 50 kHz (digital) or at a 40 kHz bandwidth (analog) the FFT value can be increased to a maximum of 128 k,
- at sampling rates higher than 50 kHz (digital) or at a 80 kHz bandwidth (analog) the FFT value is increased to a maximum of 256 k,

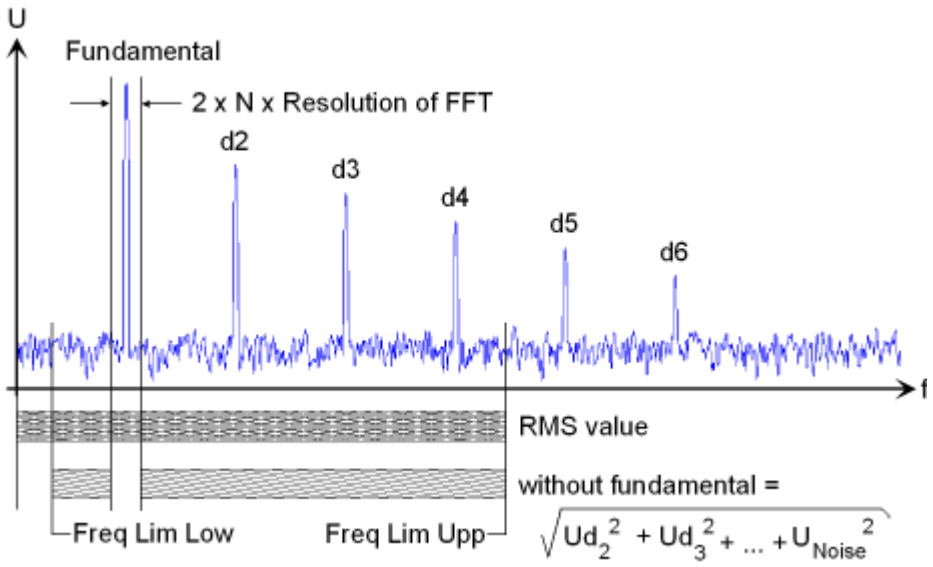
The maximum integration time in the two-channel analog analyzer (fast mode) is therefore around 1.4 s.

Sideband suppression is designed for the shortest possible measurement time. For very low frequency signals (less than 12 Hz), sideband suppression can be improved – at the cost of a longer measurement time – by increasing the minimum FFT size to 128 K (with 48 kHz sampling rate and 22 kHz bandwidth) or 256 K (with 96 kHz sampling rate and 40 kHz bandwidth).

The energy of the noise and (if applicable) the harmonics (i.e. without fundamental) can be displayed as RMS value with "Meas Mode" ="Level THD+N" or set in relationship to the total RMS with "Meas Mode" = "THD+N". The total RMS value is band-limited to "FrqLim Upp" and is identified in the following figure with **RMS value**.

An ultra-pure sine-wave signal is required as the measurement signal. The selected frequency of this sine-wave signal should be such that the significant components of the distortion spectrum are still below the upper measurement limit.

The "Sine" signal function of the internal generator is recommended as the signal source. The sine-wave level and frequency can be varied or swept.



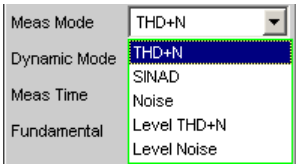
SCPI command:

SENSe[1]:FUNCtion `THDNsndr`

For alternative distortion measurement, see chapter 5.23.2, "THD", on page 370.

For more distortion measurements, see chapter 5.23, "Distortion Measurements", on page 367.

Meas Mode
Used to select the THD+N measurement method and the calculation formula for the measured value.



The term **Level** indicates that the measurement result is displayed as an RMS value and is not relative to the total RMS value (as is customary with distortion measurements).

With the **Noise** measurements, it is also possible to filter all harmonics (except the fundamental) out of the overall signal.

Note: The noise energy of the respective sideband is also filtered out with each harmonic so that with very low frequencies - with theoretically with large numbers of harmonics - a large part of the noise energy is lost. To counter this, measurement is performed with a very fine frequency resolution, which (compared to the THD+N measurement) results in a considerably longer measurement time. The Level measurement modes should therefore only be used for high frequencies.

"THD+N" The **total distortion** – broadband noise **and** harmonic – is measured **relative** to the total RMS value.

$$U_{THD+N}[dB] = 20 \cdot \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + \ldots + U_{Noise}^2}}{TotalRMS}$$

The total RMS value is band-limited to Frq Lim Upp.
The measured value can be displayed in % as well as in dB.

"SINAD" Measurement method similar to THD+N, but the result is displayed as a **positive** dB value, i.e. the total RMS value is relative to the residual signal (overall spectrum without fundamental).

$$U_{SINAD}[dB] = 20 \cdot \log \frac{TotalRMS}{\sqrt{U_{d2}^2 + U_{d3}^2 + \ldots + U_{Noise}^2}}$$

The total RMS value is band-limited to Frq Lim Upp.

"Noise" The noise factor – broadband noise **without** harmonics – is measured **relative** to the total RMS value.

$$U_{Noise}[dB] = 20 \cdot \log \frac{\sqrt{U_{Noise}^2}}{TotalRMS}$$

The total RMS value is band-limited to Frq Lim Upp.
The measured value can be displayed in % as well as in dB.

"Level THD+N" The **total** distortion **voltage** – consisting of broadband noise **and** the harmonic – is measured.

$$U_{THD+N}[V] = \sqrt{U_{d2}^2 + U_{d3}^2 + \ldots + U_{Noise}^2}$$

The measured value is displayed in voltage units (volts or FS).

"Level Noise" The **noise voltage** (broadband noise **without** the harmonics) is measured.
The measured value is displayed in voltage units (volts or FS).

Remote command:
`SENSe<n1>:FUNCtion:MMODe` on page 721

Rejection
Used to select the fundamental rejection.

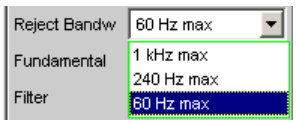
"Narrow" The fundamental is suppressed extremely narrowly. As a result, it is also possible to detect noise components which are immediately next to the carrier.

"Wide" A digital notch filter with properties like those previously common in analog measuring instruments is used to suppress the fundamental. The broader filtering range produces slightly better measured values since noise components close to the carrier are also suppressed. Recommended if the measurement results are to be comparable to those of analog measuring instruments.

Remote command:
`SENSe<n1>:THDN:REJection` on page 728

Reject Bandw
Used to select the suppression bandwidth ("Rejection Bandwidth") by implicitly entering the initial FFT value.

Only functions with deactivated Post FFT; with activated Post FFT, the initial FFT value must be specified explicitly by the user.



The larger the bandwidth is (absolute frequency band around the fundamental), the smaller the initial FFT and the higher the measurement speed will be.

The actual initial value of the FFT is determined automatically taking the sampling rate, the analog bandwidth and the dynamic range of the used analyzer into consideration.

The **final value** of the FFT is determined by the frequency of the measurement signal; it is increased automatically with low frequencies.

Apart from the measurement frequency, the actual measurement time also depends on the analog bandwidth and sampling frequency.

Note: When the Post FFT is activated, the internally calculated initial FFT value is entered in the "Min FFT Size" parameter field. It can then be freely changed by the user.

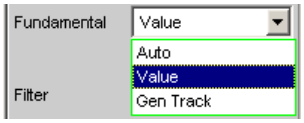
"1 kHz max" The suppression bandwidth is a maximum of 1 kHz, i.e. 500 Hz both below and above the fundamental.
The initial FFT value is very small (e.g. 1 k at an analog bandwidth of 22 kHz and a sampling rate of 48 kHz), and the measurement time is very short – especially at higher frequencies.
Non-harmonic signal components close to the fundamental are not measured.
Recommended for fast measurement of the harmonics.

"240 Hz max" The suppression bandwidth is a maximum of 240 Hz, i.e. 120 Hz both below and above the fundamental.
The initial FFT value is at least 4 k.
Compromise between measurement time and loss of sideband energy

"60 Hz max" The suppression bandwidth is a maximum of 60 Hz, i.e. only 30 Hz both below and above the fundamental.
The initial FFT value is not below 16 k.
Recommended for measuring signal components close to the fundamental and especially for noise measurements as this bandwidth ensures that the fundamentals and harmonics are suppressed as narrowly as possible.

Remote command:
SENSe<n1>:FUNCtion:APERture:MODE on page 720

Fundamental
Used to determine the fundamental frequency.



"Auto" The fundamental frequency is determined (separately for each channel) by means of internal frequency measurement.
Recommended when using an external signal source

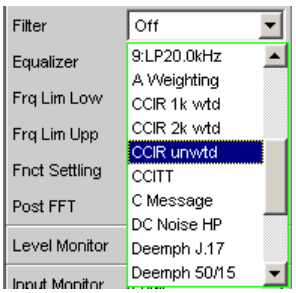
"Value " Fixed fundamental frequency; the value of which must be entered in the parameter field below

Recommended for signals with a high noise component if an external generator is used as the signal source

"Gen Track" The fundamental frequency changes with the generator (nominal) frequency. This can be changed by means of manual entry in the Generator Function panel or owing to a generator frequency sweep. Setting reliability in the case of signals with a high noise component is thus improved and measurement speed is increased.
An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or noise signal).
Recommended when using the internal universal generator.

Remote command:
SENSe<n1>:VOLTage:FUNDamental:MODE on page 727
SENSe<n1>:VOLTage:FUNDamental on page 727

Filter
Two digital filters (user-definable filters or weighting filters) in the measurement path.



The filters used here only affect the residual signal. In other words, the THD+N reference value is always the RMS signal at the Monitor level, regardless of the filters selected here.

By contrast, the input filter ("Pre Filter") affects the residual signal **and** the total RMS value.

Five measurement scenarios for THD+N, SINAD and noise can thus be distinguished based on the selected input and function filters:

- Scenario 1 – Input and function filter **off**:
  Reference value is the **un**weighted input signal, band-limited to Frq Lim Upp (such as R&S UPL / UPD **without** weighting filter).
- Scenario 2 – Prefilter **off**, function filter **on**:
  Reference value is the **un**weighted **broadband** input signal.
- Scenario 3 – Prefilter as weighting filter, function filter **off**:
  Reference value is the weighted input signal, band-limited to Frq Lim Upp.
- Scenario 4 – Prefilter as **weighting** filter, function filter **on**:
  Reference value is the **weighted**, **broadband** input signal.
- Scenario 5 – Prefilter as **lowpass** filter with cutoff frequency like Frq Lim Upp, function filter as **weighting filter**:
  Reference value is the unweighted input signal, band-limited to "Frq Lim Upp " (as with R&S UPL / UPD with weighting filter).

For a description of selectable weighting filters, see chapter 5.38, "Weighting Filters", on page 454.

Note: The previous generation of instruments R&S UPL and R&S UPD did not allow a prefilter to be selected. Consequently, only measurement scenarios 1 and 5 were possible with these instruments.

Note: The upper band limit can be limited in the analog analyzer using the "Bandwidth" parameter field, which has the same effect as an additional lowpass filter.

Remote command:
`SENSe<n1>:FILTer<n2>` on page 737
For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Frq Lim Low
Used to enter the lower band limit for calculating the distortion voltage; this limit does not affect calculation of the total RMS.

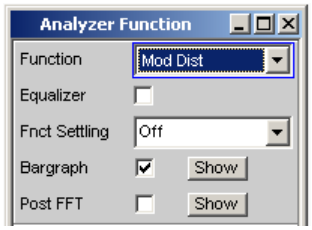
Remote command:
SENSe<n1>:FREQuency:LIMit:LOWer on page 727

Frq Lim Upp
Used to enter the upper band limit for calculating the distortion voltage **and** the total RMS value.

Note: If the fundamental of the measurement signal is above "Frq Lim Upp", the referenced measurements (THD+N, SINAD and Noise) are not to be performed because the energy of the fundamental is filtered out in the reference value. An error message appears in the user info line and the measured value is identified as invalid (---).

Remote command:
SENSe<n1>:FREQuency:LIMit:UPPer on page 727

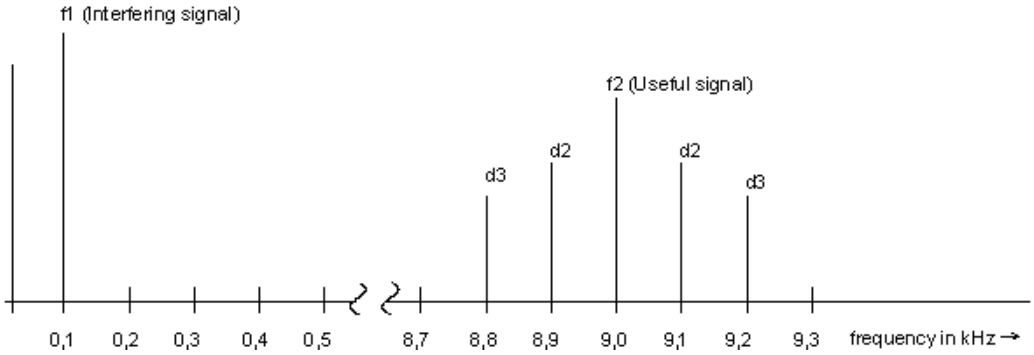
5.23.4 MOD DIST



Mod Dist is a modulation factor analysis which determines the intermodulation of a low-frequency (dominant) interfering signal to a high-frequency useful signal. According to IEC 60268 Part 3, the interfering signal should be 60 Hz and the useful signal should be 7 kHz; the amplitude ratio should preferably be 4 : 1. The R&S UPP measures the 2nd and 3rd order intermodulation products selectively (measurements are therefore largely unaffected by noise) and calculates their square sum. Contrary to the recommendation in IEC 60268, the **total** intermodulation factor is therefore measured to ensure that this measurement method is comparable to the customary SMPTE measurement method.

The measurement algorithm is highly tolerant with respect to the level ratio of the interfering signal to the useful signal. The level of the interfering signal is allowed to reach up to 48 dB below the level of the (higher-frequency) useful signal. The level of the useful signal may be max. 68 dB lower than that of the interfering signal.

The "Mod Dist" signal function of the internal universal generator is recommended as the **signal source**. This allows the frequencies of the interfering and useful signal as well as their amplitude ratio to be varied. Furthermore, it is also possible to sweep the total level and useful frequency.



$$d2 = \frac{|U_{(f1+f2)}| + |U_{(f2-f1)}|}{U_{(f2)}}$$

2nd order intermodulation product (5 - 1)

$$d3 = \frac{|U_{(f2-2f1)}| + |U_{(f2+2f1)}|}{U_{(f2)}}$$

3rd order intermodulation product (5 - 2)

$$MODDIST[dB] = 20 \cdot \left(\lg \sqrt{d2^2 + d3^2} \right)$$

Total intermodulation factor in dB (5 - 3)

SCPI command:

SENSe[1]:FUNCtion `MDISt`

For alternative intermodulation measurement, see chapter 5.23.5, "DFD", on page 384.

For more distortion measurements, see chapter 5.23, "Distortion Measurements", on page 367.

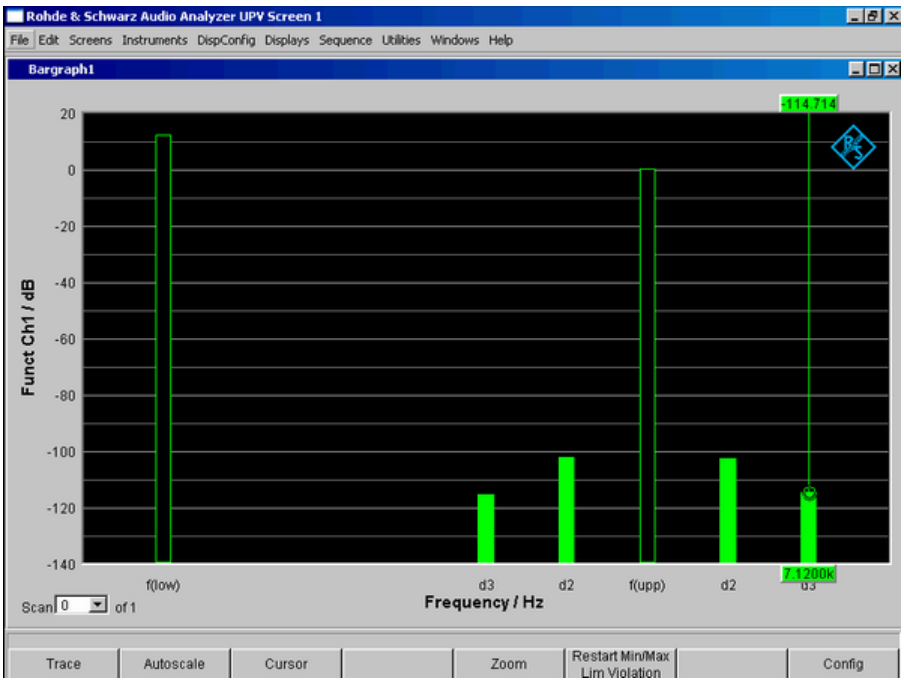
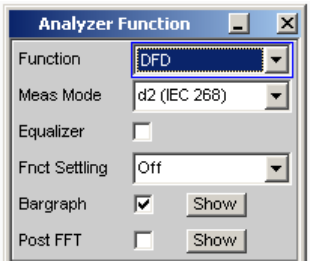


Fig. 5-10: Mod-Dist measurement with 7 kHz useful signal and quadrupled interferer at 60 Hz

5.23.5 DFD



DFD is a difference-tone factor analysis which determines the intermodulation products generated by two sine-wave signals of the same amplitude. Depending on the selected measurement mode, the R&S UPP measures the 2nd or 3rd order intermodulation products selectively in accordance with DIN IEC 60268 Part 3. Measurements are therefore largely unaffected by noise. The arithmetical center frequency of the double-tone signal should be selected from the third-octave band (5, 6.3, 8, 10, 12.5, 16, 20 kHz) and the frequency difference should preferably be 80 Hz.

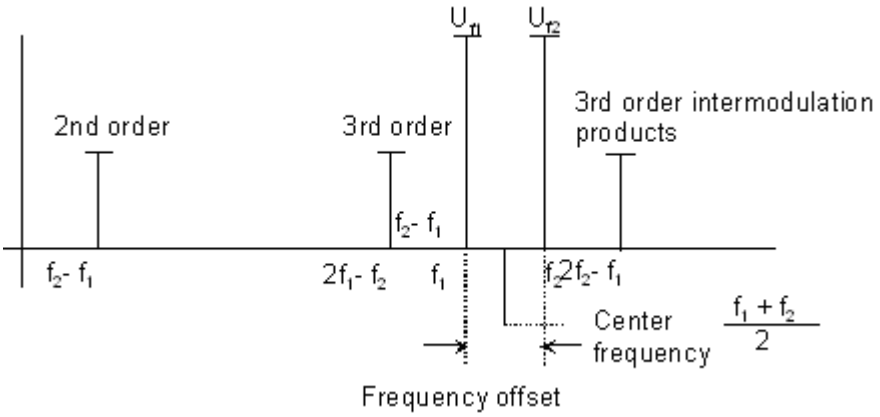
The "DFD" signal function of the internal universal generator is recommended as the **signal source**. This allows the center frequency and difference frequency (for IEC 60268) and the upper frequency and difference frequency (for IEC 60118) to be varied. Furthermore, it is also possible to sweep the center frequency and upper frequency.

SCPI command:

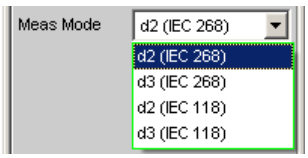
SENSe[1]:FUNCtion `DFD`

For alternative intermodulation measurement, see chapter 5.23.4, "MOD DIST", on page 382.

For more distortion measurements, see chapter 5.23, "Distortion Measurements", on page 367.



Meas Mode
Used to select the order of the intermodulation products and the measurement standard.



IEC 60268 applies the measured intermodulation products to the double upper frequency; IEC 60118 applies them to the single upper frequency only. The results according to IEC 60268 are therefore approx. 6 dB better than the results according to IEC 60118.

"d2 (IEC 268)" Measurement of the 2nd-order intermodulation product relative to the **double** amplitude at the upper frequency (acc. to IEC 60268):

$$d_2[dB] = 20 \cdot \lg \frac{|U_{(f2-f1)}|}{2 \cdot U_{(f2)}}$$

"d3 (IEC 268)" Measurement of the 3rd-order intermodulation products referenced to the **double** amplitude at the upper frequency (acc. to IEC 60268):

$$d_3[dB] = 20 \cdot \lg \frac{|U_{(2f2-f1)}| + |U_{(2f1-f2)}|}{2 \cdot U_{(f2)}}$$

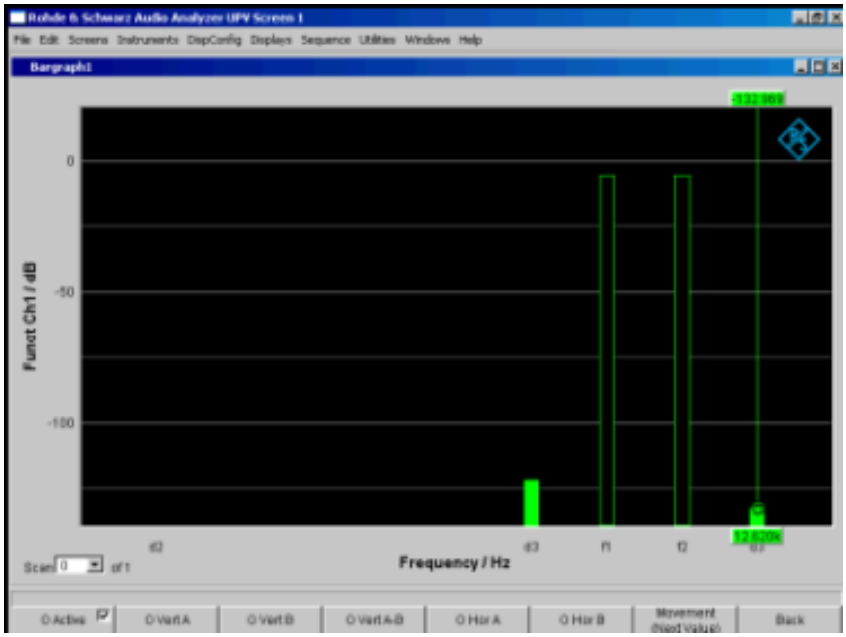


Fig. 5-11: DFD-d3 measurement in accordance with IEC 60268

"d2 (IEC 118)" Measurement of the 2nd-order intermodulation product referenced to the **single** amplitude at the upper frequency (acc. to IEC 60118):

$$d_2[dB] = 20 \cdot \lg \frac{|U_{(f2-f1)}|}{U_{(f2)}}$$

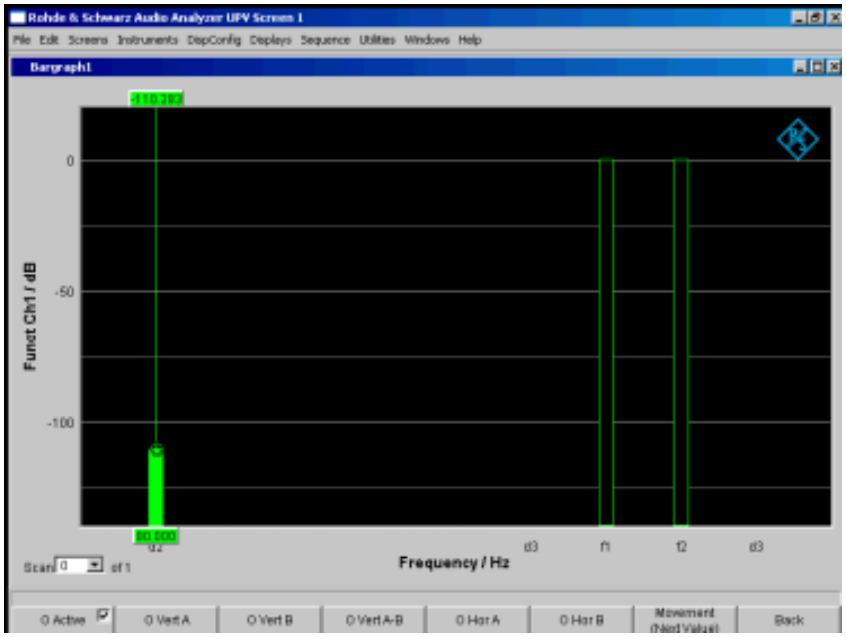


Fig. 5-12: DFD-d2 measurement in accordance with IEC 60118

"d3 (IEC 118)" Measurement of the lower 3rd-order intermodulation product referenced to the single amplitude at the upper frequency (acc. to IEC 60118):

$$d_3[dB] = 20 \cdot \lg \frac{|U_{(2f1-f2)}|}{U_{(f2)}}$$

Remote command:
`SENSe<n1>:FUNCtion:MMODe` on page 721

5.24 Polarity Measurement

Polarity measurement is used to test whether a DUT (such as a cable) forwards an applied signal with the identical or reversed polarity.

To determine the polarity, a peak measurement is performed for a measurement time of 20 ms and the highest positive peak is compared with the highest negative peak.

The signal applied to the DUT must therefore fulfill the following requirements:

- The positive amplitude must be greater than the negative amplitude.
- The repetition rate must be 50 Hz or an integer multiple thereof.

The "Polarity" signal function of the internal universal generator is recommended as the **signal source**. However, the polarity signals of other R&S audio analyzers (e.g. R&S UPL, R&S UPD, R&S UPV) can also be used. If using an external signal source, something like a sine² burst signal with 50 % duty cycle can be applied.

Function
Switching the measurement function to polarity measurement

The measurement result for the function is displayed as

- + 1.0 Pol for a **non**-reversed signal and
- – 1.0 Pol for a reversed signal

.

No further settings are needed.

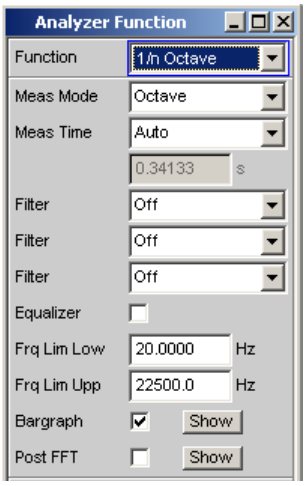
Note: When using polarity signals that are not DC free, measurements in the analog analyzer should preferably be performed using DC coupling in order to keep the negative amplitude as low as possible.

Remote command:
SENSe[1]:FUNCtion `POLarity`

5.25 Frequency Band Analysis

5.25.1 Nth Octave Analysis

This measurement function is only available if the R&S UPP K601 (1/n-octave analysis) option is installed. It is offered for all analyzer instruments.



Only two filters are offered for the R&S UPP.

Nth octave analysis is a selective level measurement performed simultaneously in a number of adjacent frequency bands. The levels of the individual frequency bands are, however, not measured by narrow bandpass filters as in the case of conventional octave or third analysis, but instead with the aid of a special high-resolution FFT by integration of the FFT bins (frequency lines) in the respective band.

The advantage compared to the filter method is the significantly higher frequency resolution, which enables bandwidths down to 1/24th of an octave. The bandwidth of the subbands is theoretically fully scalable by varying "n" or using frequency tables, such as the "Critical Bands" defined by means of the Bark scale. The advantage compared to pure FFT is the logarithmic or user-definable stepping of the frequency range.

Each subband has the relative bandwidth of upper band limit minus lower band limit:

$$\sqrt[2n]{2} - \frac{1}{\sqrt[2n]{2}}$$

Relative bandwidth (5 - 4)

Referred to the band center this gives the following results:

- Octave analysis 70.71 %,
- Third octave analysis (third analysis) 23.16 %,
- Sixth octave analysis 11.56 %,
- Twelfth octave analysis 5.78 %,
- Twenty-fourth octave analysis 2.89 %,

The reference frequency is 1 kHz. All other band center frequencies are computed by reference to this frequency by multiplying or dividing by $2^{\frac{1}{n}}$.

Selecting the frequency bands to be measured involves specifying the upper and lower limit frequencies. A separate RMS value is determined for each selected frequency band by integrating all the FFT bins in the said band together with the attenuated bins in the adjacent band. The total RMS value of all the selected frequency bands is applied to the display of measurement results for the function.

The measurement range of the nth octave analysis starts at a nominal band center frequency of 16 Hz and ends at half the sampling rate or the bandwidth of the analog analyzer.

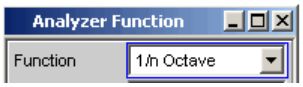
The exact, computed frequency bands are used in measurements and for numerical displays (e.g. with the X value displayed graphically as a cursor or for values displayed in the "Data List"). The nominal band center frequencies (in line with DIN 323) are given only for the numerical display of the third and the twelfth octave. Only the octave frequencies are captioned in the graphical display due to space restrictions.

Since nth octave analysis is usually performed in the audio range only, the bandwidth in the analog analyzer should be set to 22 kHz. This avoids not only needlessly large FFTs but also long computation times.

A good candidate for use as the excitation signal in the nth octave analysis is the frequency-defined Pink Noise that can be created with the R&S UPP Generator (see chapter 5.6.7, "Random", on page 239). Unlike white noise, $\sqrt{1/f}$ its level roll-off compensates for the apparent level increase encountered with nth octave analysis, which results from the absolute bandwidth increasing as the frequency increases. If possible the spacing of the frequency lines on the FFT size should be synchronized ("Spacing Anlr Track").

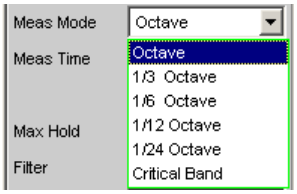
Function
For selecting FFT based nth octave analysis.

The RMS value of the signal is displayed in the range "Frq Lim Low" to "Frq Lim Upp" as the measurement result for the function.



Remote command:
SENSe[1]:FUNCtion `NOCTave`

Meas Mode
This defines the measurement mode and thus implicitly the center frequencies and relative bandwidth of the bandpass filters.



The center frequencies of the subbands are spaced at intervals of $2^{1/n}$ from the 1 kHz reference frequency. The exact values can be taken from the Data List bargraph.

The band limits of a subband are at a distance of $2^{1/(2*n)}$ from the center frequency.

The larger the chosen value of "n" the narrower the bands and the longer the minimum measurement time.

"Octave" The audio range is divided into octave bands.

"1/3 Octave" The audio range is divided into third octave bands.

"1/6 Octave" The audio range is divided into sixth octave bands.

"1/12 Octave" The audio range is divided into twelfth octave bands.

"1/24 Octave" The audio range is divided into twenty-fourth octave bands. Due to the extremely narrow bands, analysis is only possible with effect from 21.5 Hz.

"Critical Bands" The audio range is divided into "critical bands" according to the Bark scale. The band limits are on the Bark scale and the center frequencies are 0.5 Bark above the lower band limit in each case.
Due to the division into "critical bands" the low frequency bands are wider than in the case of the comparable third octave analysis, for which reason both the required FFT size and the measurement time are smaller.

Remote command:
SENSe<n1>:FUNCtion:MMODe on page 721

Meas Time
For selecting the measurement time.

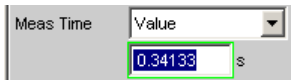
The minimum measurement time is the same as the sampling time of the FFT and is therefore defined by the FFT size used. When a longer measurement time is selected, a greater number of FFTs is performed and averaged, reducing both the update rate and fluctuations in the measured values.

In turn the required FFT size is dependent on the sampling rate or the analog bandwidth and the width of the narrowest subband, that is, on the measurement mode and the lower band limit.

"Auto" This sets the minimum possible measurement time.

This setting is recommended for the purpose of measuring independently of the lower band limit and measurement mode, and always using the highest measurement speed.

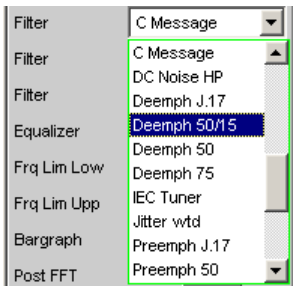
"Value " A numerical value for the measurement time is entered in the next parameter field.



The measurement time entered is rounded to an integer multiple of the minimum measurement time and thus implicitly defines the number of averages.
This setting is recommended for the purpose of reducing the update rate and fluctuations in the measured values.

Remote command:
SENSe<n1>:FUNCtion:APERture:MODE on page 720
SENSe<n1>:VOLTage:APERture on page 721

Filter
Activating a digital filter in the test channel. Up to two user-defined or weighting filters can be looped into the test channel:



Only two filters are offered for the R&S UPP.

The user-definable filters are configured as filters 01 to 09 in the filter panel (see chapter 5.37, "User-Definable Filters", on page 446) and can then be used (repeatedly if necessary) in the analyzer.

For more information on the available weighting filters, see chapter 5.38, "Weighting Filters", on page 454.

Note: Regardless of the digital filters selected here, a further input filter ("prefilter") can be looped into the test channel. Moreover, the analog bandwidth can be restricted with the aid of the "Bandwidth" parameter field, which corresponds to an additional lowpass filter.

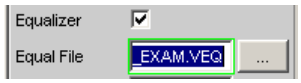
Remote command:

`SENSe<n1>:FILTer<n2>` on page 737

For a description of the filters and their setting parameters, see chapter 5.36.4, "Filter Table", on page 446.

Equalizer

Used for activating/deactivating a precorrector table for the FFT bins.



In this way, the frequency response of a transmission link can be precorrected, for example, and in so doing the measurement point is transformed into another reference point.

When precorrection is enabled the computed FFT bins are multiplied by a frequency-dependent factor after which they are used to calculate the nth octave bands and applied to the display.

The factor is determined by interpolation between the two adjacent frequency reference points in the precorrector table.

Precorrection of the FFT spectrum is an attractive alternative to filtering the input signal, since the precorrector file can simply be generated from the frequency response requiring precorrection and need not be in the form of a coefficient file or pole/zero file.

Application:

In acoustic measurements (e.g. with mobile telephones) on artificial ears of type 3.2 or higher, it is possible to compensate for the transfer function ERP (ear reference point) to DRP (drum reference point). Measurement of the sound waves by the microphone applied to the "eardrum" can thus be referred to the required measurement point (at the auricle).

Note: The precorrector table is created after acquiring or reading in the trace data from the "DUT" in the "DispConfig" panels.

"deactivated" The precorrector is disabled. The FFT bins are used and displayed without change. The levels of the subbands are calculated from the original FFT spectrum.

"activated" The precorrector is enabled. The next entry field, which is "Equal File", for the file name of the precorrector table, is activated and the file shown there is loaded. The levels of the subbands are calculated from the precorrected FFT spectrum.

Remote command:
`SENSe<n1>:VOLTage:EQUalize` on page 726
`MMEMory:LOAD:IEQualize` on page 725

Frq Lim Low
For entering the lower band limit for computing the subbands and the total RMS value.

Display and computation of the subbands starts at the band in which the lower limit frequency is located. The lower subband is measured in full, that is, the limit frequency entered does not alter the energy content of the lower band.

The lower the frequency of the lower limit frequency, the narrower the frequency bands which have to be measured. In order to not to drop below a minimum number of bins per band, the FFT resolution and the FFT size must be increased in the narrower frequency bands.

The lower limit frequency therefore has a decisive influence on the measurement speed and should therefore not be lower than the measurement task requires.

Remote command:
`SENSe<n1>:FREQuency:LIMit:LOWer` on page 727

Frq Lim Upp
For entering the upper band limit for computing the subbands and the total RMS value.

Display and computation of the frequency bands ends at the band in which the upper limit frequency is located. The upper subband is measured in full, that is, the limit frequency entered does not alter the energy content of the upper band.

The upper limit frequency has no effect on the measurement speed.

Remote command:
`SENSe<n1>:FREQuency:LIMit:UPPer` on page 727

Bargraph
Used for activating bar graph computation and display. In addition the "Bargraph1" window can be opened from here.

Configuration of the bar graphs is reserved for the "Bargraph1 Config" and/or "Bargraph2 Config" windows. The actual display takes place in the "Bargraph1" or "Bargraph2" windows.

"deactivated" Bargraph computation (and update) disabled. Only the band-limited total RMS value is measured.

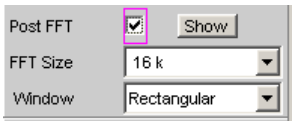
"activated" Bargraph computation (and update) enabled.

Remote command:

SENSe<n1>:FUNCtion:BARGraph on page 726

Post FFT

For activating/deactivating Post FFT. At the same time it is possible to switch between automatic and manual selection of the FFT size and window. In addition the "FFT Graph1" window can be opened from here.



Configuration of the FFT Graph is reserved for the "FFT Graph1 Config" and/or "FFT Graph2 Config" windows. The actual display takes place in the "FFT Graph1" or "FFT Graph2" windows.

"deactivated" Post FFT deactivated.
The necessary Post FFT size is computed automatic from the sampling rate and the width of the narrowest subband (defined by the lower limit frequency and the measurement mode).
The received samples are weighted using the Hann window function.

"activated" Post FFT is enabled and can be displayed. The FFT size and window can be selected manually.

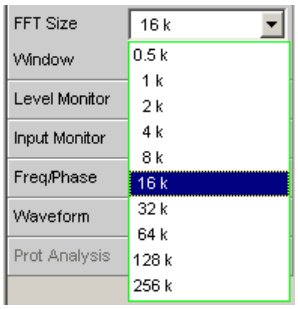
Note: When Post FFT is turned on the FFT size and window are loaded with the recommended standard settings. The manual settings are discarded when Post FFT is turned off.

Remote command:

SENSe<n1>:FUNCtion:FFT:STATe on page 726

FFT Size

This is the FFT size to be used in computing the subbands, and is adjustable in powers of 2 from 512 (0.5 k) to 256 k.



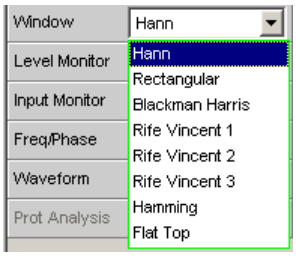
When using manual selection the FFT size should not be less than the recommended value (which is produced when Post FFT is activated), otherwise there will be too few FFT bins in the lower subbands.

With every increase in FFT size the measurement accuracy and stability increase, particularly in the relatively narrow lower subbands. At the same time, however, the measurement time doubles.

Unnecessarily high FFT sizes should be avoided in order to reduce measurement times.

Remote command:
`SENSe<n1>:FUNCtion:FFT:SIZE` on page 730

Window
Selection of the window function.



For details, see chapter 5.26.2, "Window Function", on page 397.

5.26 FFT Analysis

The "FFT" analysis (**F**ast **F**ourier **T**ransformation) enables the input signal to be displayed in the spectral range (frequency range). For this purpose, the (digitized) input signal is recorded over a selectable period and transformed into the frequency range by a fast "DFT" (**D**iscrete **F**ourier **T**ransformation). The result is a "list" of equidistant frequency lines (bins) which indicate the magnitude or the phase of the respective frequency components. The graphical display of the magnitude or phase bins is referred to as a spectrum or spectral display.

According to system theory, the "FFT" analysis assumes that the signal is periodic, i.e. it continues continuously beyond the observed time period. Since this ideal state only exists in a few exceptional cases, the input signal can if required be weighted using a window which attenuates both ends of the observed signal section with respect to zero.

The recording time for the "FFT", i.e. the length of the measurement interval (integration time), is determined using the **FFT** size and, like the frequency resolution, also depends on the sampling rate and bandwidth used.

In the R&S UPP, 2 different types of "FFT " can be selected:

- The "Post FFT" for distortion measurements is calculated with double precision using up to 256 k points, thus ensuring a very high frequency resolution and dynamic response. The size of the FFT and the used window cannot be selected, but instead are preset according to the requirements of the respective measurement function. The Post FFT is displayed in the "FFT Function" graphical window.

- The "FFT as measurement function" (Function FFT) is, like the Post FFT, also calculated with double precision but additionally allows a number of other functions such as averaging and undersampling (limiting the frequency range to increase the frequency resolution) as well as free selection of the FFT size and window. The Function FFT is displayed in the "FFT Function" graphical window.

5.26.1 Size of the FFT

The size of the FFT together with the sampling rate and bandwidth determines the length of the measurement interval (integration time) and thus the frequency resolution of the calculated spectrum. The following correlations apply:

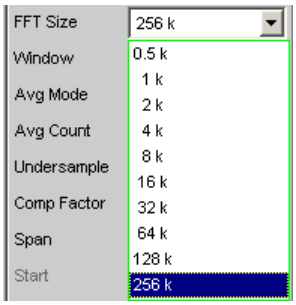
- Integration time = FFT size / Sampling rate
- Number of lines = FFT size / 2
- Frequency resolution = Sampling rate / FFT size = 1 / Integration time

Therefore, if a higher sampling rate and bandwidth are used, a higher FFT size will be required to produce the same frequency resolution.

Other variables which appear as display fields in the group of FFT parameter fields are derived from the FFT size, see "Resolution " and "Meas Time ".

In the analog analyzer, the internal sampling rate is determined by the selected bandwidth.

FFT Size
Size of the "Function FFT ", can be set in powers of 2 from 512 (0.5 k) to 256 k.



Not only the integration time but also the time required to calculate the transformation and graphical display increase with increasing FFT size. This results in an disproportionate increase in the total measurement time. Unnecessarily high FFT sizes should therefore be avoided in order to reduce the measurement time.

Note: For the Post FFT, no fixed "FFT size" but only a (variable) lower limit ("Min FFT Size") can be entered. The measurement function carried out in each case can dynamically increase the FFT size as a function of the measurement signal frequency.
Other variables which appear as display fields in the group of FFT parameter fields are derived from the "FFT size":

Remote command:
`SENSe<n1>:FUNCtion:FFT:SIZE` on page 730

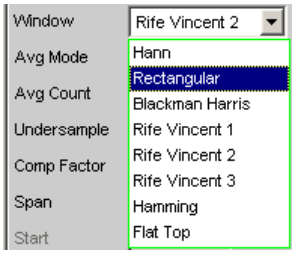
5.26.2 Window Function

According to system theory, the FFT analysis requires a periodic signal which continues continuously beyond the observed time period. Normally, however, there is no continuous continuation (even with periodic signals). The FFT would interpret any discontinuity at the boundaries of the signal section as a pulse whose (white) spectrum would be superimposed on the useful signal spectrum. In order to prevent this "leakage" effect, the input signal is weighted using a window which attenuates both ends of the observed signal section with respect to zero. As a result, the signal is continuous for the FFT; there is, however, a reduction in selectivity, indicated by a relatively wide bell-shaped curve. By selecting the window function, the user makes a compromise between selectivity (frequency selectivity, width of bell-shaped curve at top), crosstalk between adjacent lines (width of bell-shaped curve at bottom), slope of the bell-shaped curve and "leakage" suppression in the far-off range.

Selecting the rectangular window deactivates windowing.

Window
Selection of the window function.

With the Post FFT of the distortion and level measurements, the window cannot be selected by the user but instead is preset by the respective measurement function and displayed here.



"Hann" This window combines selectivity with good leakage suppression in the "far-off range " but has a relatively wide bell-shaped curve around the signal lines.
Recommended application: Standard window.

"Rectangular" Window function deactivated (by using a rectangular window with a constant weighting of 1).
If the signal fits in the section for the FFT exactly with an integer multiple of periods, there is no discontinuity at the section boundaries. A window is then not required and the maximum frequency resolution is possible. This feature may be of advantage when using a special generator signal ("FFT noise") as it allows fast measurement of frequency responses at specific frequencies.
Recommended application: Feasible only with special signals.

"Blackman Harris" Only for Function FFT.
The slope of the bell curve is very steep up to approx. 80 dB; below that, however, this window has considerable leakage.

"Rife Vincent x"	The suppression of far-off interference is very good for all 3 windows. The width of the bell-shaped curve at the bottom of the individual lines drops and the width at the top increases as the Rife Vincent number increases. It is therefore possible to set various compromises between frequency resolution and the suppression of adjacent lines. Recommended application: For exact determination of frequency
"Hamming"	This window does not provide any significant advantages; it was implemented simply to complete the range.
"Flat Top"	Only for Function FFT. Here, the region around the carrier is deliberately distorted to such an extent that at least two adjacent lines (in the case of excitation with one sinusoidal line only) always have roughly the same magnitude. This allows the amplitude to be read off very precisely from the graph. In contrast, the frequency selectivity is rather poor. Recommended application: For exact determination of amplitude

Remote command:
`SENSe<n1>:FUNCtion:FFT:WINDow` on page 730

5.26.3 Post FFT

For distortion measurements, the Post FFT displays the frequency spectrum recorded for calculating the measured values. It can be activated for the measurement functions THD+N & SINAD, THD, DFD and Mod Dist, as well as for RMS measurements.

Measurement is performed in the same level as the associated measurement function, i.e. downstream of all filters.

The respective measurement function adjusts the FFT size and window to its specific requirements. For example, the required FFT size increases as the signal frequency decreases. The settings for the Post FFT cannot therefore be selected by the user and can vary from measurement to measurement.

The Post FFT is calculated with double precision using up to 256 k points, thus achieving a very high frequency resolution and dynamic response.

The Post FFT of a measurement channel is displayed in the graphical windows "FFT, Panel 1" or "FFT, Panel 2" either as a magnitude or phase. Since 2 traces are displayed in each graphical window, the magnitude and phase of both channels can be recorded simultaneously.

Post FFT
Used to activate the Post FFT. In addition the "FFT Graph1" window can be opened from here.

Configuration of the FFT Graph is reserved for the "FFT Graph1 Config" and/or "FFT Graph2 Config" windows. The actual display takes place in the "FFT Graph1" or "FFT Graph2" windows.

Note: In measurement functions for which users cannot select Post FFT, this menu line is grayed out. In this case, there are two options:
1. FFT is not needed by any currently selected measurement and is therefore not computed in order to save time. There is no live FFT in the FFT graph.

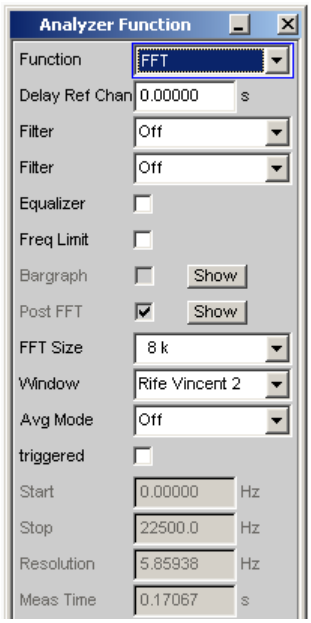
2. FFT is needed by at least one selected measurement (e.g. phase measurement, precision frequency measurement) and cannot be deactivated. The internally used FFT can be displayed in the FFT graph.

"deactivated" Post FFT deactivated.
Recommended for increasing the measurement speed (e.g. for sweeps or remote control).

"activated" Post FFT activated; all other settings are determined dynamically by the associated measurement function.

Remote command:
SENSe<n1>:FUNCtion:FFT:STATe on page 726

5.26.4 FFT Measurement Function



The "FFT" can be selected as a separate measurement function (Function FFT). Unlike the other FFT analyses, all FFT parameters can be determined by the user.

The following additional functions are also available:

- Delay compensation
- DC suppression (digital only)
- Filtering (2 user-definable filters)

- Averaging

Measurement is performed in the same level as the other measurement functions, i.e. downstream of all filters.

The Function FFT is calculated with double precision using up to 256 k points, thus achieving a very high frequency resolution and dynamic response.

The Function FFT of a measurement channel is displayed in the graphical windows "FFT, Panel 1" or "FFT, Panel 2" either as a magnitude or phase. Since 2 traces are displayed in each graphical window, the magnitude and phase of both channels can be recorded simultaneously.

only in generator and analyzer:

analog only:

Function
Used to change the measurement function to FFT analysis.

The band-limited and, possibly, filtered RMS is displayed as the function measurement result. The RMS is calculated by means of integration over all magnitude frequency lines from "Start" to "Stop".

The frequency and phase value derived from the FFT is displayed as the "Freq/Phase" measurement result if "Precision" is set as "Meas Time" for the frequency measurement.

With AC coupling (analog) or "DC Suppress" (digital), the DC component (bell-shaped curve) is not included in the measurement. If a Window function is used, it is 5 bins wide, so the bottom 6 bins are not included in the RMS result.

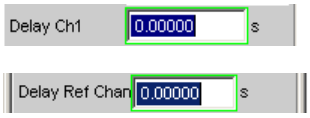
Note: To include very low frequency signals in the RMS measurement, either the FFT size must be selected sufficiently large (so that the desired signal components are above the 6th bin, or the square window must be used (which ignores only the DC bin).

The panel segment shown here represents a digital FFT that is band-limited to 12 kHz.

With this FFT the "Start" value is always 0.0 Hz; the "Stop" value is the resulting bandwidth. Resolution and Meas Time depend on the selected FFT size.

Remote command:
SENSe[1]:FUNCtion FFT

Delay Ch1, Delay Ref Chan
Used to activate the delay compensation.



This compensates delay differences of the DUT.

Two-channel analyzers:

The time by which Channel 1 is to be offset relative to Channel 2 is entered. If the delay of Channel 2 is shorter than that of Channel 1, this can be compensated by entering a negative time.

Multichannel analyzers:

The time by which the channel specified as the "Ref Channel " in the Analyzer Config Panel is to be offset relative to the other channels. If the delay of the other channels is shorter than that of the "Ref Channel ", this can be compensated by entering a negative time.

The compensation of delay differences is particularly useful for phase measurements since a time offset of both measurement signals causes a frequency-dependent phase displacement and can thus invalidate the phase measurement result.

Note: Delay compensation cannot be selected when the "Compressed" or "Undersample" waveform modes are used.

Remote command:
SENSe<n1>:CHANnel:DELay on page 729

DC Suppress
Used to activate DC suppression (in the digital analyzer only).

For DC suppression in the digital analyzer, the DC level is measured in the Monitor level and subtracted from the input samples.

This parameter field is not available in the analog analyzer because the suppression function is already provided by the AC coupling which can be set up using the hardware.

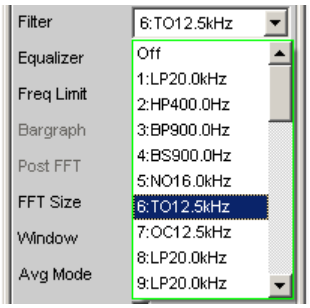
"deactivated" DC suppression deactivated.
The DC component of the measurement signal is not suppressed ("DC coupling") and is included in the measurement result and the graphical display.
Recommended when using a highpass or bandpass filter because additional DC suppression is not necessary in these cases and would increase the calculation time (slightly).

"activated" DC suppression activated.
The DC component of the measurement signal is suppressed ("AC coupling"); the measurement result and the graphical display only include the AC component.

Remote command:
SENSe<n1>:FUNCtion:DCSuppression on page 725

Filter
2 separate filters can be looped into the measurement path. Apart from those filters which can be user-defined in the filter panel, filters can also be selected from a set of supplied weighting filters.

Selecting "OFF" deactivates the respective filter.



Remote command:
SENSe<n1>:FILTer<n2> on page 737

Equalizer
Used for activating/deactivating a precorrector table for the FFT bins.

In this way the frequency response of a transmission link can be precorrected, for example, and in so doing the measurement point is transformed into another reference point.

When precorrection is enabled the computed FFT bins are multiplied by a frequency-dependent factor after which they are used to calculate the total RMS value and applied to the display.

The factor is determined by interpolation between the two adjacent frequency reference points in the precorrector table.

Precorrection of the FFT spectrum is an attractive alternative to filtering the input signal, since the precorrector file can simply be generated from the frequency response requiring precorrection and need not be in the form of a coefficient file or pole/zero file.

Application:

In acoustic measurements (e.g. with mobile telephones) on artificial ears of type 3.2 or higher, it is possible to compensate for the transfer function "ERP " (ear reference point) to "DRP " (drum reference point). Measurement of the sound waves by the microphone applied to the "eardrum" can thus be referred to the required measurement point (at the auricle).

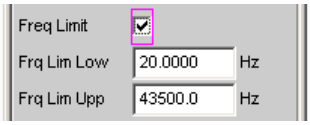
Note: The precorrector table is created after acquiring or reading in the trace data from the "DUT" in the "DispConfig" panels.

"deactivated" The precorrector is disabled. The FFT bins are used and displayed without change.

"activated" The precorrector is enabled. The next entry field, which is "Equal File", for the file name of the precorrector table, is activated and the file shown there is loaded.

Remote command:
`SENSe<n1>:VOLTage:EQUalize` on page 726
`MMEMory:LOAD:IEQualize` on page 725

Freq Limit
RMS value calculation on the basis of the FFT bins between frequency marks

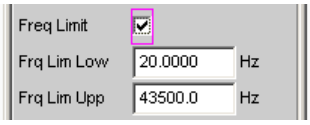


"deactivated" The frequency limits for calculating the RMS value from the FFT bins is based on the Start and Stop values of the FFT (shown but not accessible), i.e. the calculation is broadband-based.

"activated" The bandwidth for calculating the RMS value from the FFT bins can be limited. In the two following fields, the lower and upper band limits are indicated – as for the THD+N measurement.
When the bandwidth is reduced, the device only looks for the frequency in this range when in "Meas Time " = "Prec " measuring mode. If the frequency of the broadband signal is to be determined, either the time for measuring the frequency must be set to "Meas Time " = "Fast " or the bandwidth limitation must be disabled.
When the AC coupling is enabled (or "DC-Suppress" in the digital range), the RMS calculation starts above the DC bell curve. When the Window function is disable, i.e. "Window " = "Rectangular ", only the DC bin, and otherwise the first 6 bins, are suppressed. Thus, with DC suppression the actual lower frequency limit depends on the Window function, which means that the FFT size may be larger than the value selected by the user.
Applying band limits that have been limited with both of the following parameter fields to the limit values of the x-axis in the FFT graphic would not be desirable in most cases, and is not done.

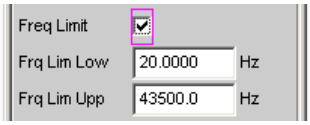
Remote command:
`SENSe<n1>:FREQuency:LIMit` on page 729

Freq Lim Low
Lower band limit for RMS value calculation based on the FFT bins.



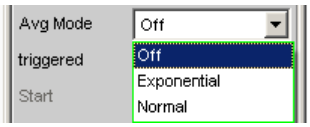
Remote command:
SENSe<n1>:FREQuency:LIMit:LOWer on page 727

Freq Lim Upp
Upper band limit for RMS value calculation based on the FFT bins.



Remote command:
SENSe<n1>:FREQuency:LIMit:UPPer on page 727

Avg Mode
Used to activate the averaging function and select the averaging method.



When averaging is activated, an additional parameter field appears in which the average count can be specified.

Note: The energy of the individual bins is averaged, not their levels. This is necessary so that the displayed RMS value, which is computed by integration over all bins (of the averaged FFT), can be correctly determined.

"OFF" No averaging; each FFT analysis result is displayed immediately and is independent of previous analyses.

"Exponential" Averaging is performed continuously and displayed. When the current result is calculated, the previous measurements are taken into consideration using a constant factor. The weighting of the current measurement (n) and of the previous measurements (n-1) is determined by the selectable average count (k); the displayed result of the nth measurement (n =2) is derived using the following formula:

$$AVG(n) = \frac{1}{k} \cdot FFT(n) + \frac{k-1}{k} \cdot AVG(n-1)$$

"Normal" The specified number of FFT cycles is performed, the partial results added together and then divided by this number. The result does not appear until all "k" cycles have been completed.

Remote command:
SENSe<n1>:FUNCtion:FFT:AVERage:MODE on page 729

Avg Count
Used to enter the average count; only if averaging is activated.

With "normal averaging", the number entered here determines how many consecutive FFTs are used for averaging.

With "exponential averaging", the number "k" entered here determines the extent to which the previous measurements are taken into consideration in the result. The weighting of the previous measurements is (k-1)/k.

If, for example, k = 20 is entered as the average count, the current analysis result is weighted by 5 % and the previous measurements by 95 %.

Remote command:
SENSe<n1>:FUNCtion:FFT:AVERage on page 729

triggered
Triggered FFT

Selectable only with averaging switched off.

"deactivated" Untriggered FFT

"activated" Triggered FFT
The trigger condition is set in the Waveform menu.
Forces activation of the waveform in "Meas Mode " "Standard ".
All triggers can be selected, including "Manual" (results in untriggered operation and is therefore not recommended) and "Genburst"
A "Pretrigger" can be selected.
The parameter field "Autotrigger " at the end of the Waveform menu is permanently disabled (view only) to ensure that data is only collected when the trigger condition occurs.

Remote command:
SENSe<n1>:FUNCtion:FFT:TRIGgered on page 730

Start
Start value of the FFT frequency band (display only)

Remote command:
SENSe<n1>:FUNCtion:FFT:STARt? on page 730

Stop
End value of the FFT frequency band (display only)

In the case of a wideband FFT in the digital analyzer, this is 23 or 48 times the sampling frequency; in the case of an undersampled FFT, the value here is the "Span" value less one bin.

Remote command:
SENSe<n1>:FUNCtion:FFT:STOP? on page 730

Resolution ← Stop
Displays the frequency resolution.

The frequency resolution is the quotient of sampling rate and FFT size.

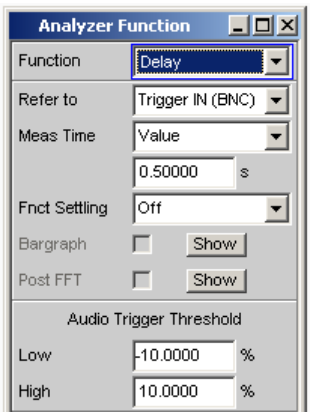
Remote command:
SENSe<n1>:FUNCtion:FFT:RESolution? on page 729

Meas Time ← Stop
Displays the integration time.

The integration time is the quotient of FFT size and sampling rate.

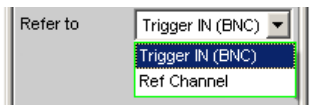
Remote command:
SENSe<n1>:FUNCtion:FFT:MTIMe? on page 729

5.27 Delay Measurement



With the "Delay" measurement function it is possible to determine the delay time between analog signals. When the measurement starts, the observed signals must have a low amplitude; therefore a suitable measurement signal would be, for example, the burst signal generated by the R&S UPP. The time until the "Audio Trigger Threshold" is exceeded is measured. To achieve a short rise time, work with signals of the highest possible frequency and a high bandwidth (80 kHz in the generator and analyzer).

Refer to



This menu item determines the signal to which the delay is referenced. If this signal is missing or its amplitude is too low, the measurement cannot be carried out.

"Trigger IN (BNC)" The reference time is when there is a positive TTL amplitude at the rear BNC socket, which is labeled with "TRIGGER IN". The delay time of all switched-on audio channels is referenced to this time.

"Ref Channel" The reference time is when the "Audio Trigger Threshold" of the selected reference channel is exceeded. The delay time of the other switched-on audio channels is referenced to this time.

Remote command:
`SENSe<n1>:FUNCtion:REFTo` on page 731

Meas Time
Selection of the measurement time for adapting to various delay times.

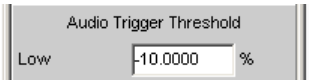
"Value " The RMS measurement is performed over a preset time which must be entered in the parameter field below.

Numeric input of the measuring time. All desired signals (including the reference signals) must have occurred within this time. Channels with a longer delay time are labeled as invalid after this time expires and the user info line displays a short note. All measurement results are updated after this time. Thus for continuous measurement this numerical value also determines the repetition rate of the measurement.

Remote command:
`SENSe<n1>:FUNCtion:APERture:MODE` on page 720
`SENSe<n1>:VOLTage:APERture` on page 721

Fnct Settling
See chapter 5.35, "Settling Methods", on page 435.

Auto Trigger Threshold Low

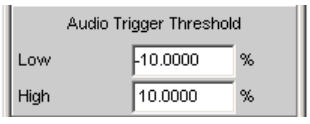


Negative percentage trigger threshold, relative to the nominal RMS value of the range selected for this channel. For a threshold of -10%, therefore, the analog signal in the range "200 mV RMS" would trigger at a peak value less than -28.28 mV.

The delay time of a channel is triggered, that is, determined up to the time when the audio signal first exceeds the "high" threshold or first undershoots the "low" threshold.

Remote command:
`SENSe<n1>:LIPSync:AUDio:THReshold:LOW` on page 734

Auto Trigger Threshold High



Positive percentage trigger threshold, relative to the nominal RMS value of the range selected for this channel. For a threshold of +10%, therefore, the analog signal in the range "800 mV RMS" would trigger at a peak value greater than 226.27 mV.

The delay time of a channel is triggered, that is, determined up to the time when the audio signal first exceeds the "high" threshold or first undershoots the "low" threshold.

Remote command:

`SENSe:LIPSync:AUDio:THReshold:HIGH` on page 731

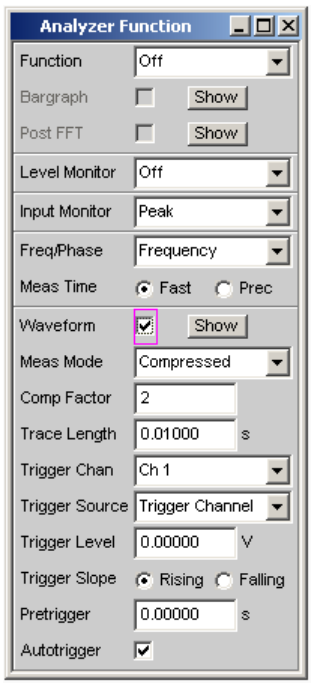
5.28 Analysis in the Time Domain

Besides analysis in the frequency domain, the R&S UPP can also be used to analyze input signals in the time domain. Time and frequency-domain analyses can be performed simultaneously and irrespective of the selected measurement function.

5.28.1 Waveform Monitor

The waveform monitor is used for signal analysis in the time domain. Both channels of the active analyzer can be measured and displayed simultaneously and synchronously.

- The "Analyzer Function" panel is used to activate the waveform monitor and to configure its trigger condition and memory depth. The Waveform graphics dialog can also be opened from here.
- The scaling (including limit checking and the reference source) are selected in the Waveform Config panel.
- The graphic display is shown in the Waveform graphics dialog.



Waveform
Used to activate the waveform monitor; the **graphic** is configured and displayed in the Waveform "(Config)" configuration and graphical window.

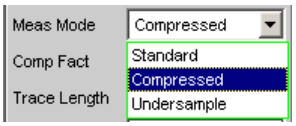
Click the "Show" button to open the Waveform graphic. As with any other window, the graphic can be closed by clicking over the title bar with the mouse, provided it is the active window.

"deactivated" Waveform monitor deactivated
Recommended for increasing the measurement speed (e.g. for sweeps or remote control).

"activated" Waveform monitor activated; the parameter fields shown above appear.

Remote command:
SENSe7:FUNCtion `ON | OFF`

Meas Mode
Used to select the operating mode.



"Standard" Uncompressed recording of all samples. A maximum of 480000 samples can be stored. The possible recording length depends only on the bandwidth (analog) or sampling rate (digital). At a sampling rate of 48 kHz or an analog bandwidth of 22 kHz the probable time is 10 s. Recommended for short recordings (maximum of a few seconds) and for periodic signals.

"Compressed" Compressed recording of the samples produced by peak value rectification. Specifying a value (n) for the "Comp Fact" (compression factor) in the next operator field means that the highest value out of every n consecutive samples is determined and this peak value is used as the input signal for the waveform function. The maximum recording time increases in proportion to the factor n.
Since this waveform contains only positive data, a logarithmic display is possible.
Recommended for recording low-frequency signals if the Standard recording time is too short or the only aspect of interest is the peak value trace (envelope).

Note: "Delay Ch1" or "Delay Ref Chan" (only for the "FFT" measurement function) cannot be used in this mode and is thus set to 0 s.

"Undersample" Compressed recording of the samples produced by undersampling. Specifying a value (n) for the "Comp Fact" (compression factor) in the next operator field means that only every nth sample is recorded. The maximum recording time increases in proportion to the factor n. Recommended for recording low-frequency signals if the standard recording time is too short and the aspect of interest is the **signal trace** over time.

Note: "Delay Ch1" or "Delay Ref Chan" (only for the "FFT" measurement function) cannot be used in this mode and is thus set to 0 s.

Remote command:
`SENSe7:MMODe` on page 732

Comp Factor
Used for entering the compression factor in compressed recording.

The factor entered here is the factor by which
- the maximum recording and pretrigger times increase compared to standard recording
- the time resolution deteriorates compared to standard recording

The size of the trace memory (480000 samples) and pretrigger memory (19200 samples) remain unaffected.

A reduction in the compression factor reduces the maximum possible recording time and therefore where appropriate also the set recording and pretrigger times.

An increase in the compression factor does not alter the set recording time, but only the maximum possible recording and pretrigger times. You can then set a longer recording time ("Trace Length") and a longer pretrigger time.

Remote command:
`SENSe7:CMPFactor` on page 731

Trace Length
Used to enter the recording length (memory depth), including an optional pretrigger, in seconds.

A maximum of 48000 samples can be stored. Apart from the bandwidth (analog) and sampling rate (digital), the possible recording length also depends on the selected operating mode (the compression factor):
- The higher the bandwidth or sampling rate is, the shorter the maximum possible recording length will be.
- The recording length can be multiplied by using one of the compression modes.

Note: If a multichannel analyzer is used, max. 1.44 million samples can be monitored. For an analog bandwidth of 40 kHz, for example, this corresponds to 15 s. Therefore, the recording length is automatically limited to this time when of the compression modes is used.

The recording length does not depend on the length of the time axis (selected in the "Waveform Config" panel).

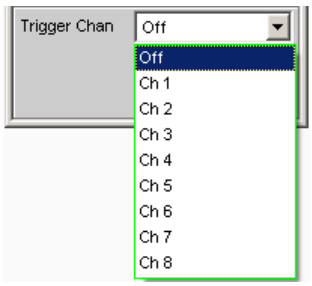
The lower the selected recording length is, the higher the update rate for the graphic will be.

If a long recording duration is set, any section of the recorded samples can be analyzed by reducing the graphical time axis (also possible at a later stage).

Note: The selected "Trace Length" (not the length of the displayed trace section) determines the recording duration for each measurement and thus also the total measurement time. If a high measurement speed is required (e.g. for sweeps or remote-control mode), the memory depth should not be longer than the measurement time of the measurement function.

Remote command:
`SENSe7:TRIGger:TRCLength` on page 732

Trigger Chan
Used to select the channel whose event triggers a measurement.

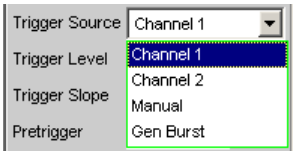


If a measuring channel which was inactive is selected as a trigger channel it is automatically switched on. A warning appears if the channel selected as a trigger channel is switched off.

Switching off the measuring channel, which was selected as the trigger channel, therefore changes the trigger channel after this warning has been acknowledged.

Remote command:
`TRIGger:CHANnel` on page 703

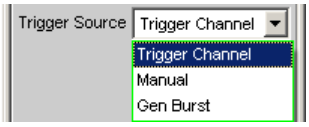
Trigger Source
Used to activate the trigger and to select the trigger source.



Note: If Undersample FFT is enabled, the waveform trigger source cannot be selected. Instead, it is automatically set to Manual.

Selects the source (usually one of the measurement channels) which is to trigger measurement recording if the trigger threshold is overranged or underranged.

Note: In the case of multichannel analyzers, the trigger channel must be defined before it can be used as trigger source for the waveform. If no trigger channel is activated, the trigger source is automatically set to "Manual".



"Channel 1" Measurement channel 1 triggers recording.
Only available in the two-channel analyzers if measurement channel 1 (or both channels) is activated.

"Channel 2" Measurement channel 2 triggers recording.
Only available in the two-channel analyzers if measurement channel 2 (or both channels) is activated.

"Trigger Chan" The measurement channel selected as "Trigger Chan" triggers the recording.
Only available in the multichannel analyzers if the trigger channel is not deactivated.

Note: If the trigger channel is deactivated, the "Trigger Source" is not operable.

"Manual" Recording is triggered as soon as the measurement starts.

"Gen Burst" Recording is synchronized to the start of the generator signal (preferably Sine Burst).
The generator signal is first muted briefly (approx. 3 ms) and then restarted with zero-degree phase ("Burst On" phase). Measurement data recording is started at the same time, taking internal signal delays into account.
It is thus possible to graphically determine the signal delay of the device under test from the waveform display by selecting "Gen Burst" and using a suitable signal from the internal generator (see chapter 5.28.2, "Delay Measurement", on page 414).

Note: In this mode, the settling time of any filter that may be enabled is not taken into account for starting the measurement. In other words, the measurement starts without any delay and thus includes the settling time response of the filters.

Remote command:
`SENSe7:TRIGger:SOURce` on page 732

Trigger Level
Entering the trigger level

Recording is triggered according to the ""Trigger Slope"" when this level is overranged or underranged.

When measurement has been started or recording has been triggered (in the case of continuous measurement), a new recording cycle is not armed again until the trigger threshold is violated in the opposite direction.

Remote command:
SENSe7:TRIGger:LEVel on page 732

Trigger Slope
Used to select the signal edge on which measurement is to be triggered (trigger slope).

"Rising" "Triggering" as soon as the level of the trigger threshold in the channel selected as trigger source is reached for the first time.
(Re-)arming takes place as soon as a level below the trigger threshold occurs.

"Falling" The "Triggering" takes place when the level on the measurement channel selected as the "Trigger Source" first falls below the trigger threshold.
(Re-) "arming " occurs as soon as a level above the trigger threshold exists.

Remote command:
SENSe7:TRIGger:SLOPe on page 732

Pretrigger
Used to activate the pretrigger and to enter the pretrigger interval in seconds:

The pretrigger is deactivated by entering a pretrigger time of 0.0 s.

Entering a pretrigger time moves the instant known as the trigger time within the recording time selected as the "Trace Length".

The pretrigger memory is 19200 samples in size, that is 4 % of the maximum possible trace length. With a compressed waveform display ("Compressed" or "Undersample"), the maximum possible pretrigger time (and the trace length) is increased by the compression factor.

The pretrigger memory is filled from the start of the measurement and always contains the latest samples of the time frame selected as the pretrigger, before triggering occurs. For so long as the pretrigger is not completely full, triggering remains locked. It is only armed when the pretrigger memory is full and is at least one sample below the trigger threshold.

The pretrigger memory is filled from the front in the manner of a shift register, so that the older samples move back one position as each new sample is added:

- If the pretrigger time is longer than the total trace length, triggering takes place when the trace length is reached. The pretrigger memory (which is only partially full) is then displayed.
- If the desired pretrigger interval has expired, the older samples in the back part are replaced by newer samples.

The **trigger time** is always t = 0.0 s, the pretrigger time is given as a negative time.

Note: The total length of the waveform trace is 480000 samples and is entered under Trace Length. If the pretrigger is used, the recording duration for the triggered section of the signal is reduced.

Remote command:
SENSe7:TRIGger:PRE on page 732

Autotrigger
For activating the autotrigger, that is, forced triggering, when the trigger condition is not fulfilled ("true") within the time selected as "Trace Length".

"deactivated" Autotrigger off
The triggering of waveform recording – and thus the termination of a single measurement that has been started – occurs only when the trigger event has occurred (i.e. has changed to "true").
If an unfavorable trigger condition is chosen (e.g. the trigger level is too high) the measurement continues indefinitely and must be interrupted manually (STOP key).
This setting is recommended if the waveform is to be displayed only if the trigger condition is fulfilled.

"activated" Autotrigger on
When the trace length has expired, forced triggering occurs, that is, the waveform is then displayed untriggered, as in the case of manual triggering.
This setting is recommended if you wish to ensure that the measurement terminates, or in the case of an unknown signal trace.

Remote command:
SENSe7:TRIGger:AUTO on page 732

5.28.2 Delay Measurement

The delay measurement function is used to measure signal propagation delay in a DUT (e.g. between the input and the output). For this purpose, a known signal is applied to the input of the DUT and the time required for the signal to appear at the output of the DUT is measured.

With this type of measurement, it is essential for the time measurement to be started exactly when the signal appears at the input of the DUT, i.e. at the output of the generator. The internal delays of the generator and the analyzer must be taken into account automatically. To allow measurements to be made at the D/A and A/D converters, this synchronization must effectively extend over both domains – from analog to digital and from digital to analog.

Just like the previous UPP devices, the R&S UPD and R&S UPL – the R&S provides a specific waveform measurement mode for this measurement task: Gen Burst mode. In this operating mode, the start of the measurement (and thus the start of waveform recording) is synchronized to the start of the generator signal (preferably Sine Burst):

- The generator signal is muted briefly (approximately 3 ms) and then restarted with zero-degree phase (in the case of a burst signal with "Burst On")
- The analyzer does not start recording until it receives an internal trigger signal from the generator and the internal signal delays of the generator and analyzer being used have expired.

As the generator signal contains an (intentional) signal dropout and reset at the start of each measurement cycle in this operating mode, it should only be used for measuring delays and not for measuring signal quality.

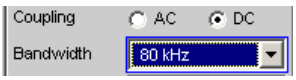
The delay of the DUT can be read directly from the waveform display by comparison with the start of the generator signal. A sine burst signal is particularly suitable for this type of measurement, since it has a zero level before and after the burst if the "Low Level" value, burst duration and burst interval parameters are suitably configured.

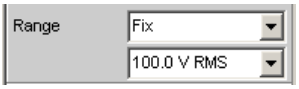
Internal triggering to the generator signal cannot be applied if a multichannel analyzer is used. Instead, however, one of the measurement channels – as reference and trigger channel – can record the generator signal and trigger the waveform measurement while two other channels are displayed as waveform.

Sine Burst is equally suitable for single and continuous measurements, since the trigger for the next measurement is automatically re-armed by the burst pause. However, any other type of generator signal can also be used for single measurements, since the start of the signal can be recognized from the brief signal blanking interval. The settings for operation with a sine burst signal are described below:

To run the delay measurement as a continuous measurement or sweep, Burst must be selected as the generator function with Low Level = 0 (no offset) so that arming can be performed by the burst pause.

- The measurement can be made using "one or two channels". If only one signal is to be observed, the unused channel should be disabled in the Analyzer Config panel, and Trace B should be disabled in the Waveform Config panel.
- The "Filter" and "Equalizer" should not be used unless absolutely necessary. If a filter or filters are used, it must be borne in mind that the settling of the filter will be visible in the waveform trace, since in this case the start of the measurement cannot be delayed by the filter settling time as is otherwise usual.
- For "analog measurements, " the Autoranger must be switched off (Range Fix for the measurement channels used), and the input coupling must be set to DC. A range that is large enough to acquire the expected signal level without overranging must be selected. For very long delays (> 2 s) the bandwidth must be reduced.



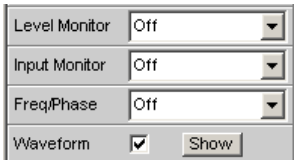


- With "pure analog measurements" (analog generator and analog analyzer), the generator and analyzer should be configured with the same bandwidth. With "D/A measurements", it is recommended that you adapt the generator bandwidth to the analyzer sampling rate (i.e. 22 kHz bandwidth for 48 kHz sampling rate, 40 kHz bandwidth for 96 kHz sampling rate, 80 kHz bandwidth for 192 kHz sampling rate).

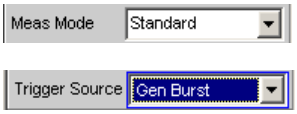
- For evaluation of the measurement, the "waveform window" must visible and a vertical graphic cursor (or two cursors for two-channel measurements) must be enabled ("Movement Next Sample"). With a two-channel measurement, this allows the relative delay of the two measurement signals to be read in addition to the absolute delay of each signal.

  The x-axis should initially be scaled automatically so that the entire waveform trace can be seen. The graphic zoom function can then be used for more precise examination of the signal start.

- A measurement function with a short measurement time (such as FFT with a size of 1 k) should be selected in the "Analyzer Function Panel", and all unnecessary supplementary "measurement functions" (especially frequency and level monitoring) should be disabled. The Waveform Monitor must be enabled.



- "Meas Mode Standard" should be selected in the "Waveform menu" (Analyzer Function Panel); it is not necessary to select "Undersample" except for very long delays (> 9 s). "Trigger Source" must be set to "Gen Burst".



- The "generator function" should always be set to "Sine Burst", although other types of signals from the internal generator can also be used for single measurements.
- The "Low Level " of the burst signal must be set to "0.0" (V or FS), especially for continuous measurements, so that the burst pause can arm the trigger for the next measurement. The voltage must be greater than 0.0; otherwise the message "No Generator Signal" will be displayed and it will not be possible to trigger the measurement.
- "Burst on Delay" is normally not necessary. It can be used to lengthen the standard generator mute time (3 ms) at the start of the measurement.

The following settings depend on the length of the expected delay and apply to the generator "Sine Burst" function:

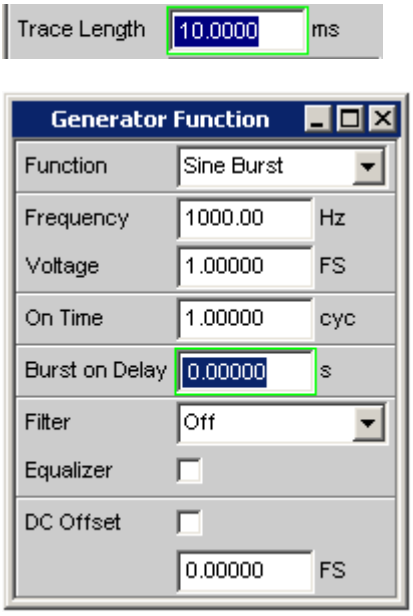
- The "recording length" (Trace Length) should be around 110% of the maximum expected delay, but at least 10 ms. Reducing the recording time increases the

update rate with continuous measurements and the time resolution of the graphic display.

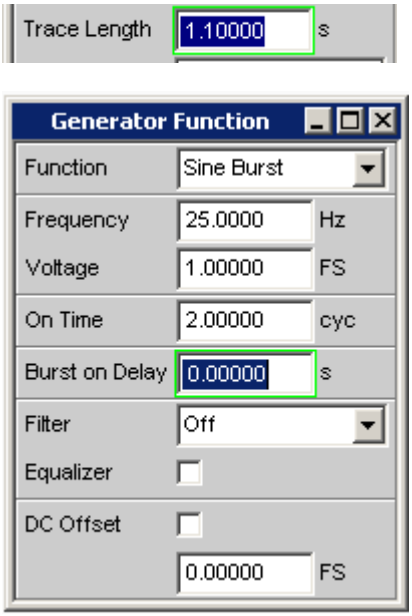
- The "frequency " of the burst signal should be selected such that the period of the signal is approximately 2% to 10% of the recording length. If possible, it should be a subharmonic of the generator sampling frequency.
- The "burst duration" should not exceed 10% of the recording time, and it should be set to an integer multiple of the period (1 to 5 cycles) so that the test signal will not have a DC component.

The following two examples show configurations for very short (1 ms) and very long (1 s) delays:

Delay DUT 1 ms



Delay DUT 1 s



5.29 Protocol Analysis

To be able to select the protocol analysis in the **digital audio** instrument, the R&S UPP B2 (digital audio interface) option **and** the R&S UPP K21 (digital audio protocol) option have to be installed.

To be able to select the protocol analysis in the **HDMI** instrument, the R&S UPP B4 (HDMI and digital audio interfaces) option **and** the R&S UPP K45 (advanced audio/ video measurements) option have to be installed, which include the stream header analysis function.

The Digital Audio interface can be used not only to analyze the audio data content of both channels, but also at the same time to decode the channel-status information and display transmission errors by means of error flags.

5.29.1 Activating and Configuring the Protocol Analysis

The protocol analysis is configured in the Analyzer Function panel. The channel-status information and error flags are displayed in a separate window known as the Dig Analyzer Protocol window. This window can be opened via the "Menu bar - Displays - Dig Analyzer Protocol" from within the Analyzer Config panel or from within the Analyzer Function panel.

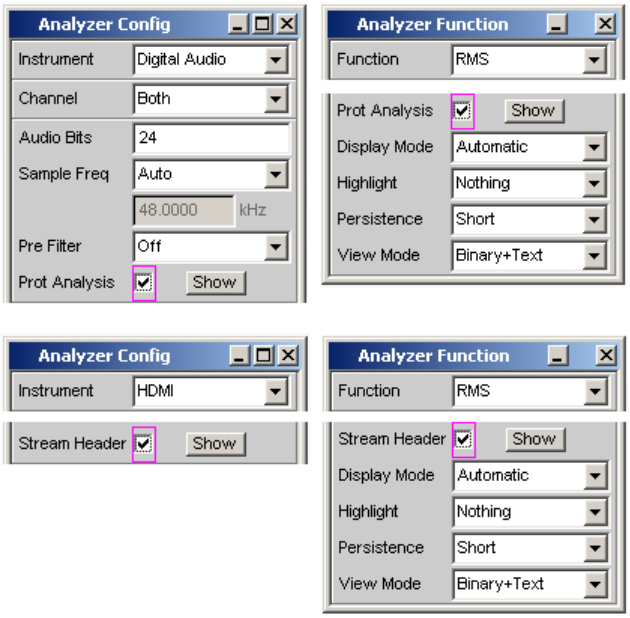
The setting parameters for the protocol analysis appear at the end of the Analyzer **Function** panel.

Prot Analysis / Stream Header
For activating the protocol analyzer.

Depending on the selected analyzer instrument "Digital Audio" or "HDMI", the button for opening the protocol analyzer is offered either with "Prot Analysis" or "Stream Header".

The term "Stream Header" identifies a subset of audio-relevant information of the HDMI analyzer. This data structure consists only of the channel status bytes 0 to 4 of a consumer format according to IEC 60958.

Independent of it, the protocol window that is opening now will always be referred to with "Dig Analyzer Protocol" window.



Click the Show button to open the "Dig Analyzer Protocol" window. You can close the window, as with any other, by means of clicking on the title bar button ☒.

"deactivated" The protocol analyzer is off.
This setting is recommended for increasing the measurement speed (e.g. in the case of sweeps or in remote-control mode), if protocol data is not currently needed.
The current channel-status information is frozen when this feature is switched off.

"activated" The protocol analyzer is on. The parameter fields shown above are displayed.

Note: Protocol analysis in the "Digital Audio" analyzer instrument:
The internal hardware determines the channel-status information for channels 1 and 2 on a sequential basis. This information is therefore available only after 2*192 samples at the earliest. A single measurement must therefore capture at least 384 samples, which can lengthen the measurement time during fast measurements.

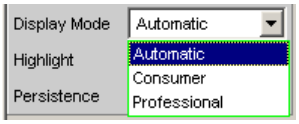
Protocol analysis in the "HDMI" analyzer instrument:

Since the stream header has no channel reference for HDMI, the channels are always represented as identical in the protocol analyzer.

Remote command:
SENSe8:FUNCtion ON | OFF

Display Mode

For selecting the display format of the channel-status information.



Depending on the format bit (bit #0 of the channel-status bits), the following bit fields have a different meaning. This menu item defines whether the channel-status information is interpreted according to the Consumer format or the Professional format.

"Automatic" The channel-status bits are interpreted in the format specified by bit #0. If this bit changes, the format is changed automatically to the correct one.

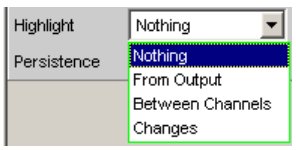
"Consumer" The channel-status bits are always interpreted in Consumer format in accordance with the IEC 60958-3 standard regardless of the state of bit #0. This avoids the possibility that a bit error in bit #0 might cause the display format to switch over.

"Professional" The channel status bits are always interpreted in Professional format in accordance with the IEC 60958-4 or AES3 standard regardless of the state of bit #0. This avoids the possibility that a bit error in bit #0 might cause the display format to switch over.

Remote command:
SENSe8:PROTocol:MODE on page 733

Highlight

For defining whether and if so when channel-status information is to be highlighted.



Highlighted channel-status information is displayed in red instead of black.

"Nothing" Channel-status information is not highlighted.

"From Output" Changes compared to the channel-status information generated by the R&S UPP generator are highlighted.
This setting is only worthwhile when the internal generator is used and channel-status information is being generated.

"Between Channels" Differences between the two channels are highlighted. The differences are displayed on both channels.
For the HDMI protocol analysis, the channels are always represented as identical, therefore the setting is without effect in this case.

"Changes" This is for highlighting all changes since the start of the measurement, that is, since the START key was last used.

Remote command:
`SENSe8:PROTocol:HIGHlight` on page 733

Persistence
For defining how long a highlight should stay.

Regardless of the setting selected here, all highlighting is reset when the START key is used.

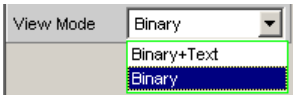
"Short" Highlighting is only brief and is reset after one second.

"Long" Highlighting is reset after five seconds.

"Forever" Highlighting is never reset.

Remote command:
`SENSe8:PROTocol:PERSistence` on page 733

View Mode
For defining how the channel-status information should appear.



"Binary+Text" The bit fields are displayed both as binary values (MSB first) and in plain text.

"Binary" The bit fields are displayed only as binary values (MSB first). This reduces the space required by the "Dig Analyzer Protocol" window.

Remote command:
`SENSe8:PROTocol:VIEW` on page 733

5.29.2 Channel-Status Information Display

The R&S UPP decodes the first five bytes of each channel and displays the current information from the individual bit fields in a readable form for both channels in the "Dig Analyzer Protocol" window.

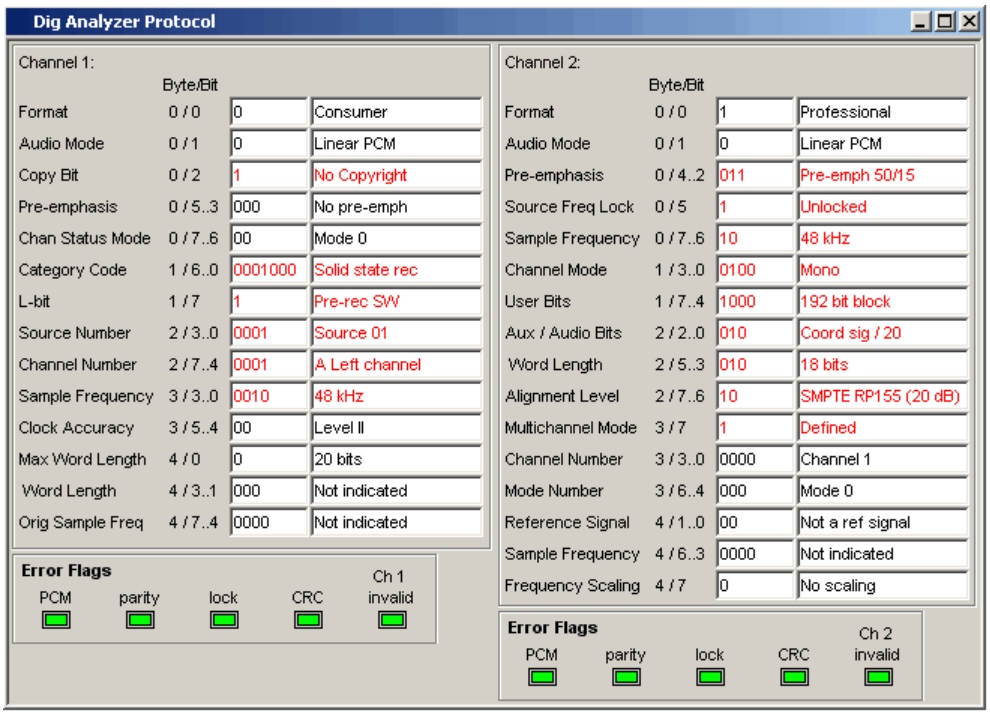
Digital Audio instrument: Channel information is always decoded and displayed for both channels, regardless of whether only one or both audio channels are being measured.

HDMI instrument: The decoding and display of the channel information is always done for one channel.

There are two different formats, defined by the value of the first bit:

- The format for the consumer area (Consumer format); bit #0 = 0
- The format for the professional area (Professional format); bit #0 = 1

In the Automatic display mode the correct format (Consumer or Professional) is set for each channel according to its format bit, so that even data streams with a different format in channels 1 and 2 can be displayed.


Dig Analyzer Protocol
Channel 1:
Byte/Bit
Format 0 / 0 0 Consumer
Audio Mode 0 / 1 0 Linear PCM
Copy Bit 0 / 2 1 No Copyright
Pre-emphasis 0 / 5..3 000 No pre-emph
Chan Status Mode 0 / 7..6 00 Mode 0
Category Code 1 / 6..0 0001000 Solid state rec
L-bit 1 / 7 1 Pre-rec SW
Source Number 2 / 3..0 0001 Source 01
Channel Number 2 / 7..4 0001 A Left channel
Sample Frequency 3 / 3..0 0010 48 kHz
Clock Accuracy 3 / 5..4 00 Level II
Max Word Length 4 / 0 0 20 bits
Word Length 4 / 3..1 000 Not indicated
Orig Sample Freq 4 / 7..4 0000 Not indicated
Error Flags
PCM parity lock CRC Ch 1 invalid
Channel 2:
Byte/Bit
Format 0 / 0 1 Professional
Audio Mode 0 / 1 0 Linear PCM
Pre-emphasis 0 / 4..2 011 Pre-emph 50/15
Source Freq Lock 0 / 5 1 Unlocked
Sample Frequency 0 / 7..6 10 48 kHz
Channel Mode 1 / 3..0 0100 Mono
User Bits 1 / 7..4 1000 192 bit block
Aux / Audio Bits 2 / 2..0 010 Coord sig / 20
Word Length 2 / 5..3 010 18 bits
Alignment Level 2 / 7..6 10 SMPTE RP155 (20 dB)
Multichannel Mode 3 / 7 1 Defined
Channel Number 3 / 3..0 0000 Channel 1
Mode Number 3 / 6..4 000 Mode 0
Reference Signal 4 / 1..0 00 Not a ref signal
Sample Frequency 4 / 6..3 0000 Not indicated
Frequency Scaling 4 / 7 0 No scaling
Error Flags
PCM parity lock CRC Ch 2 invalid

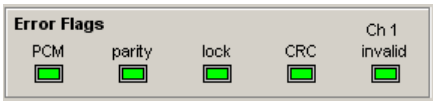
When the format is predefined the meaning of the individual bit fields, as well as the interpretation of the content and even of the position and length of the bit fields depend on other, preceding bit fields. These formats are continually being developed by the IEC standardization committee, for which reason new and previously reserved bit combinations are added. The Dig Analyzer Protocol window can be upgraded to the latest state with the aid of updates to the R&S UPP software.

The values and meanings currently available for a bit field can be found in IEC standard 60958-3 (Consumer Applications) or IEC 60958-4 (Professional Applications), or the Protocol Generator panel.

5.29.3 Error Flag Display

In addition to channel-status information, the "Dig Analyzer Protocol" window also displays the "Error-Flags " which indicate errors in the data stream. When an error occurs the color of the "LED "changes from green to red. As soon as the error disappears the "LED " goes back to green.

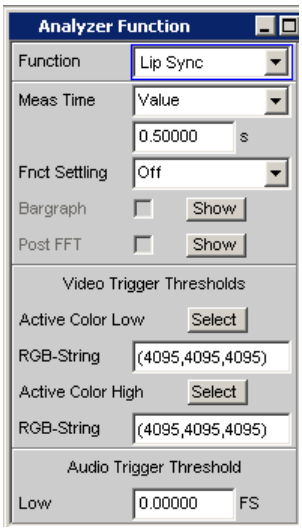
Just as with the channel-status information, the error flags are read at the end of a measurement cycle. The error flag update rate therefore depends on the measurement time of the function that has been set. In the case of single measurement the status read at the end of the measurement stays unchanged until a new measurement has started and finished.



- **"PCM"** indicates whether the signal is Linear PCM-coded (green) or not (red). This error flag corresponds to audio mode (bit #1 of the channel-status data).
- **parity** indicates whether parity checking has detected an error (red).
- **lock** indicates whether a valid digital signal is present (green); if the DUT delivers no clock or the input is open, "lock" is (red).
- In the Professional format, **CRC** indicates that CRC checking has detected an error (red). IN the Consumer format, no CRC error is indicated (green).
- **CH1 invalid** or **CH2 invalid** indicates the status of the validity bit in the protocol. Red means that the corresponding channel is invalid.

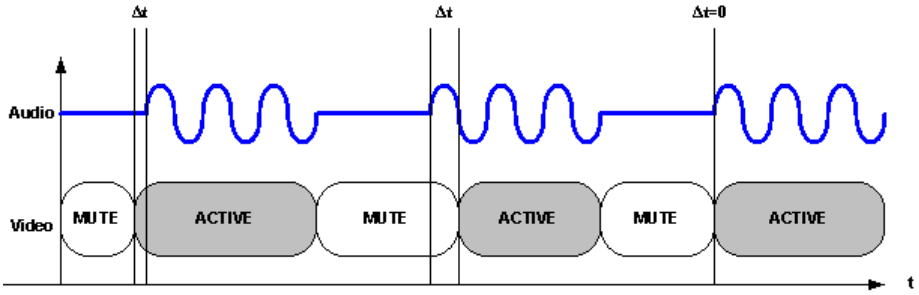
All error flags will be set (red) if a Lock error occurs.

5.30 Lip Sync analysis



Available only with the R&S UPP K45 (expanded audio/video measurements) option.

The "Lip Sync" analyzer function allows measuring a time offset between picture and sound of an HDMI transmission path. This requires an input signal with a change in picture information between two colors (Active Color and Mute Color) with sound switched on and off. The principle can be seen in the following illustration.



The "Lip Sync" generator function creates such a signal with user-configurable Active and Mute Color pattern and a time offset of 0 (see also chapter 5.6.13, "Lip Sync", on page 263).

The Lip Sync analyzer operates internally with two trigger events:

The video trigger is initiated as soon as a certain color value has been detected. With the aid of a configurable threshold, a blurriness can be implemented, for example, if the device under test reduces the color depth of the generator signal or falsifies color values.

The audio trigger is initiated as soon as an audio sample exceeds the user-configurable threshold. This allows implementing a blurriness, e.g. if the device under test performs a sample rate conversion with corresponding filtering so that the audio data in the mute phases do not measure exactly 0.

The offset of the audio signal to the video signal is measured from the time difference of the trigger events. If the time shown is negative, then the video signal leads the audio signal.

Application example for determining the threshold value in the Lip Sync analyzer measurement function

Example 1: Normal color change combination

In the "Lip Sync" generator function, a color change is configured between "Mute Color" = pure green (0,4095,0) and "Active Color" = pure red (4095,0,0). It is assumed that the DUT for all three color components causes color falsification of some bits, which is to be covered with a tolerance specification of ±100 bits. The "Mute Color" must be outside of the specified range between Threshold Low and High.

Accordingly, configure the Video Trigger thresholds in the "Lip Sync" analyzer function with "Active Color Low" = (3995,0,0) and "Active Color High" = (4095,100,100). The values 4095 and 0 cannot be exceeded or undershot.

Example 2: Influence of the Color Depth on the Video Trigger

If the "Mute Color" and "Active Color" are very close to one another due to special conditions of the DUT, the "Color Depth" in the Config range of the generator has to be taken into account when calculating the threshold. With this kind of close color changing, the DUT is not permitted to make any color falsifications. "Mute Color" = (1000,2000,3000) light blue, "Active Color "= (1010, 2010, 3010). Accordingly, the Video Trigger thresholds in the "Lip Sync" analyzer function could be configured, for example, with a tolerance of ±5 bits. "Active Color Low" = (1005,2005,3005) and "Active Color High" = (1015,2015,3015)

With a "Color Depth" of **12**, the Video Trigger is activated without any problems, since the "Mute Color" is still outside of the threshold range: "Mute Color" = (1000,2000,3000), "Active Color Low" = (1005,2005,3005), "Active Color High" = (1015,2015,3015)

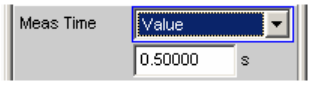
With a "Color Depth" of **8**, the last 4 bits no longer contribute to the calculation and are set to zero. The "Mute Color" would fall into the threshold range and be easy to identify if the RGB values are displayed in the hexadecimal format. "Mute Color" = (1000,2000,3000) = **3E**0h, **7D**0h, **BB**0h. "Active Color Low" = (1005,2005,3005) = **3E**0h, **7D**0h, **BB**0h. "Active Color High" = (1015,2015,3015) = 3F0h, 7D0h, BC0h. In this case, no Video Trigger would be activated!

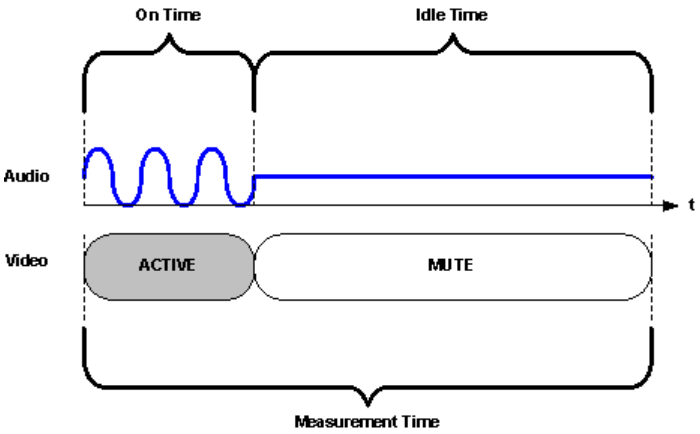
SCPI command:

SENSe[1]:FUNCtion LIPSync

Meas Time
Determines the time period (indicated with "Measurement Time" in the figure), in which the audio and video signal are observed and the periodicity of the Lip Sync pattern together with the "On Time" set in the corresponding "Lip Sync" generator function. The measurement time must always be greater than the "On Time", otherwise a corresponding message appears and the measurement is not started.

If the audio or video trigger event does not occur during the measurement time, the measurement is aborted with a "timeout" message.





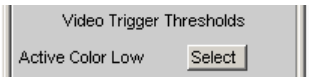
"Value " The Lip Sync measurement is performed inside a predefined time which has to be entered in the following parameter field.

Remote command:

`SENSe<n1>:FUNCtion:APERture:MODE` on page 720

`SENSe<n1>:VOLTage:APERture` on page 721

Active Color Low



The two thresholds "Active Color Low" and "Active Color High" define the condition of the video trigger for the Lip Sync measurement. The trigger condition is considered met if the individual values of the color components all fall within the two limits:

(Active_Color_Low.Red ≤ Color.Red ≤ Active_Color_High.Red)

(Active_Color_Low.Green ≤ Color.Green ≤ Active_Color_High.Green)

(Active_Color_Low.Blue ≤ Color.Blue ≤ Active_Color_High.Blue)

The color can be configured using the color selection dialog. In the following parameter field, the colors are always shown as decimal equivalents of 12-bit long numeric values. With a lower color depth in the "Color Depth" selection field in the Config range of the generator, the corresponding LSBs are not transmitted, but set to 0. For an application example, see "Application example for determining the threshold value in the Lip Sync analyzer measurement function" on page 424

RGB string

Entry option for "Active Color Low" in text form.

The color selection from the above color selection dialog above is mapped as RGB string and can be configured here, if necessary. In each case, the decimal equivalent of 12-bit long numeric values is mapped. With a lower color depth in the "Color Depth" selection field in the Config range of the generator, the corresponding LSBs are not transmitted, but set to 0.

Remote command:
SENSe<n1>:LIPSync:COLor:THReshold:LOW:STRing on page 734

Active Color High

The two thresholds "Active Color Low" and "Active Color High" define the condition of the video trigger for the Lip Sync measurement. The trigger condition is considered met if the individual values of the color components all fall within the two limits:

(Active_Color_Low.Red ≤ Color.Red ≤ Active_Color_High.Red)

(Active_Color_Low.Green ≤ Color.Green ≤ Active_Color_High.Green)

(Active_Color_Low.Blue ≤ Color.Blue ≤ Active_Color_High.Blue)

The color can be configured using the color selection dialog. In the following parameter field, the colors are always shown as decimal equivalents of 12-bit long numeric values. With a lower color depth in the "Color Depth" selection field in the Config range of the generator, the corresponding LSBs are not transmitted, but set to 0 ("Application example for determining the threshold value in the Lip Sync analyzer measurement function" on page 424).

RGB string

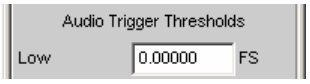
Entry option for "Active Color High" in text form.

The color selection from the above color selection dialog above is mapped as RGB string and can be configured here, if necessary. In each case, the decimal equivalent of 12-bit long numeric values is mapped. With a lower color depth in the "Color Depth" selection field in the Config range of the generator, the corresponding LSBs are not transmitted, but set to 0.

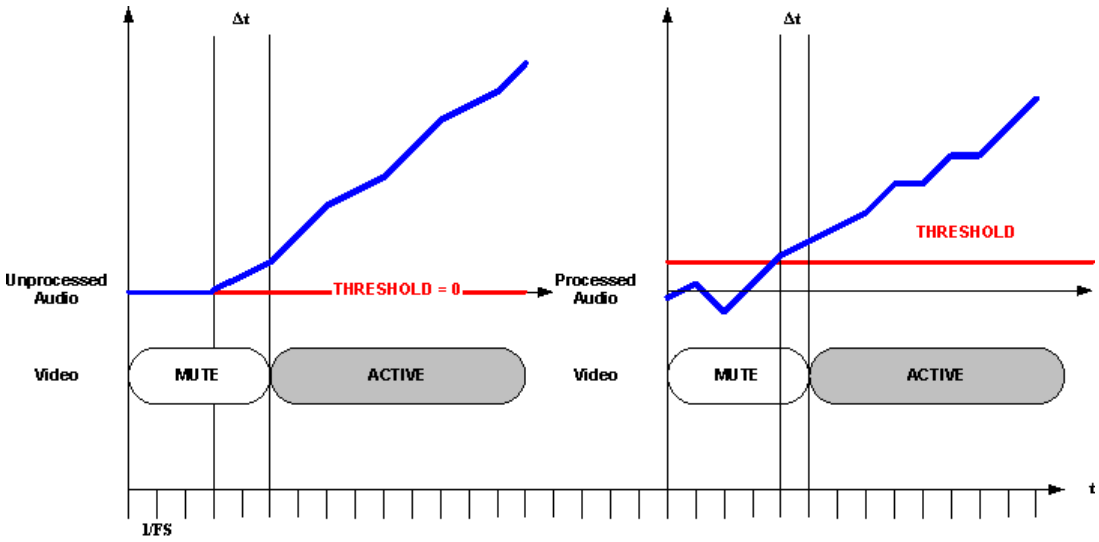
Remote command:
SENSe<n1>:LIPSync:COLor:THReshold:HIGH:STRing on page 734

Low

This threshold defines the condition of the audio trigger for the Lip Sync measurement.

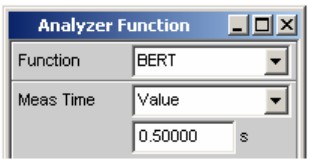


If the supplied audio data are processed in the device under test (e.g. filtering), a value greater than 0 should be defined. In such a case, the audio signal on the input side with defined signal and mute frames will no longer show any exact zero sample phases at the output of the device under test. It should be noted that the measurement result is always falsified in this case which can be seen in the following representation.



Remote command:
SENSe<n1>:LIPSync:AUDio:THReshold:LOW on page 734

5.31 BERT analysis



Available only with the R&S UPP K45 (expanded audio/video measurements) option.

The "BERT" analyzer function enables measuring the bit error rate across an HDMI transmission path by sending defined bit patterns in the picture content. The measurement can be selected only if the settings "Source" = "Intern" and "Pattern" = "BERT" have been selected in the generator, otherwise a corresponding message appears.

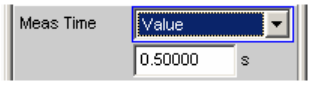
An informative measurement result is present only if a device under test outputs the received BERT pattern of the HDMI generator unchanged since the measurement compares transmitted and received data patterns with each other.

The measurement result of the bit error analysis is displayed as percentage of defective bit patterns, based on the total number of patterns transmitted during the defined measuring time.

SCPI command:

SENSe[1]:FUNCtion BERT

Meas Time
Duration of the BERT measurement. For a continuous measurement, the measurement is restarted after the measuring time expires.



"Value " The BERT measurement is performed inside a predefined time which has to be entered in the following parameter field.

Remote command:

SENSe<n1>:FUNCtion:APERture:MODE on page 720

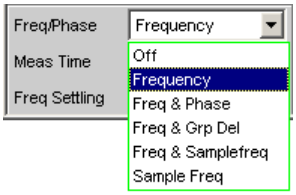
SENSe<n1>:VOLTage:APERture on page 721

5.32 Frequency, Phase and Group Delay Measurement

The frequency measurement and combined frequency/phase/group delay measurement are performed upstream of the function-specific digital filters, but downstream of the prefilter.

Freq Phase

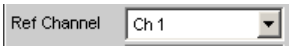
Used to activate the frequency measurement (for the reference channel) and to select the measured value for the other channels.



With 1-channel measurements, it is only possible to select the frequency measurement here; measurement of the sampling frequency can be selected here in the digital analyzer.

With 2-channel or multichannel measurements, the frequency on the other channels is often the same as the frequency on the reference channel. In such cases, it is advisable to display a frequency-related measured value instead of the frequency in the measurement window of the other channels.

Note: In two-channel analyzers, the "reference channel" is always "channel 1 ", in multichannel analyzers, the reference channel is "user-definable in the Analyzer Config Panel ".

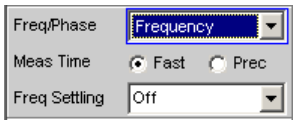


"Off" Frequency measurement is deactivated.

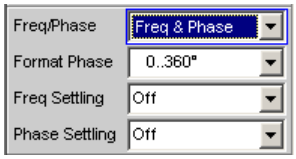
Note: For signals for which no zero crossing can be detected (e.g. weak noise signals, pure DC signals or very low frequency AC signals), the frequency measurement can be switched off, which will considerably reduce the total measurement time.

Note: For frequency measurements, the input signal – beginning in the zero crossing – must be observed over one complete period, but with at least 100 samples. For function measurements with an extremely short measurement time (e.g. peak measurement 1 ms interval), the frequency measurement should therefore be deactivated.

"Frequency" Frequency measurement is performed on all activated channels.



"Freq & Phase" Only available for two-channel measuring mode or in a multichannel analyzer.
Frequency measurement is performed on the reference channel; the measurement windows of the other channels contain the phase of the other channel referenced to the reference channel.



If a phase is shown as invalid, the frequencies of this channel and the reference channel are different or one of the channels does not have an input signal.

Note: This measuring mode should only be selected if the frequency on the reference channel is identical with the frequency on at least one other measurement channel.

"Freq & Grp Del"

Only available for two-channel measuring mode or in a multichannel analyzer.
Frequency measurement is performed on the reference channel; the measurement windows of the other channels contain the group delay of the respective channel referenced to the reference channel.

Note: This measuring mode should only be selected if the frequency on the reference channel is identical with the frequency on at least one other measurement channel. The group delay measurement should only be used in the case of frequency changes (e.g. with frequency sweeps); a group delay is not defined in the case of constant frequency.

The group delay is measured by differentiation of phase with respect to frequency, i.e. by evaluating the difference quotient.

$$t_2[s] = \frac{\Delta\varphi}{2 \cdot \pi \cdot \Delta f}$$

where

$$\Delta\varphi = \varphi_{2mes} - \varphi_{1mes}$$

The following points must be taken into consideration when selecting a frequency sweep for measuring the group delay:

- The frequency step size and the number of sweep points must be selected such that no phase shifts of more than 180° occur between two consecutive sweep points.
- The spacing should be linear; with logarithmic spacing the frequency increments at the bottom could become too small and the phase shifts at the top could become too large.
- In the case of group delay measurement over frequency (e.g. by means of a generator frequency sweep), the first sweep point is undefined because a reference point for calculating the delta values of frequency and phase is only available as of the 2nd frequency value.

Note: For signals with a poor S/N ratio, the quality of the group delay measurement can be considerably improved by increasing the "FFT size" or by "FFT" averaging (Avg Normal). "To this effect, the measurement function is to be set to FFT."

"Freq & Sample Freq"
Only available for two-channel or multichannel measuring mode in the digital analyzer.
The sampling frequency is measured on the channel last activated. On all other channels (i.e. channel 1 in two-channel analyzers), a frequency measurement is performed.

Note: In this measuring mode, the audio frequency of the last channel is not measured.

The sampling frequency is measured with a resolution of 22.9 mHz and an update interval of approx. 700 ms.

Note: If the sampling frequency is changed by more than 3 Hz, a precision measurement is performed that takes max. 1.5 s. If the "Sample Freq" measurement is activated, therefore, the total time required by a single measurement may be extended to up to 1.5 s.

"Sample Freq"
Only available in the digital analyzer.
The measurement windows contain the sampling frequency.

In this measuring mode, the audio frequency is not measured.
The sampling frequency is measured with a resolution of 22.9 mHz and an update interval of approx. 700 ms.

Note: If the sampling frequency is changed by more than 3 Hz, a precision measurement is performed that takes max. 1.5 s. If the "Sample Freq" measurement is activated, therefore, the total time required by a single measurement may be extended to up to 1.5 s.

Remote command:
SENSe3:FUNCtion `OFF | FREQuency | FQPHase | FQSamplefrequency | SFRequency`

Meas Time
Used to select the measurement speed.

"Fast" The frequency and (if applicable) phase measurement is optimized with respect to speed. A 4 k FFT is used as the measurement basis for high frequencies and the phase; low frequencies are determined by means of an evaluation of period (with interpolation). This measuring mode does not require any additional processing performance, i.e. the total measurement time of all activated measurement functions does not increase.
Recommended for pure frequency measurements on single-tone signals or for phase measurements on signals whose frequency is not too low (higher than 2 % of the bandwidth and 1 % of the sampling frequency).

Note: In the case of distortion measurements the frequency must be very accurately determined. The accurate result of this frequency measurement is then displayed. The frequency accuracy in fast mode therefore depends on the measurement function selected.

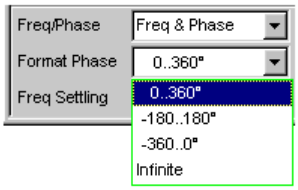
"Prec" The frequency and (if applicable) phase measurement is optimized with respect to precision. A precision FFT with up to 256 k points is used as the measurement basis. The FFT length is automatically adapted to the measured signal frequency so that measurement can always be performed with the smallest possible FFT (and, therefore, in the shortest possible time).
Depending on the activated measurement function, the total measurement time can increase in this measuring mode since it may be necessary to calculate an (additional) FFT.

Note: Digital or analog filters which are active in the activated function measurement are also used in the frequency measurement. If only the unfiltered frequency or phase measurement result is required, the function measurement should be deactivated.

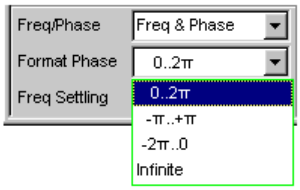
Recommended for signals with a high noise component, multi-tone signals and for measuring the phase of low frequencies.

Remote command:
`SENSe3:FREQuency:APERture:MODE` on page 734

Format Phase
Used to select the phase display format; only available if phase measurement is activated.



or



depending on whether degrees or RAD has been selected for the phase unit.

"0..360°" The phase is displayed in the range 0° to 360°; only available if "°" has been selected for the phase unit.

"-180..180°" The phase is displayed in the range +/- 180°; only available if "°" has been selected for the phase unit.

"-360..0°" The phase is displayed in the range -360° to 0°; only available if "°" has been selected for the phase unit.

"0..2π" The phase is displayed as a radian from 0 to 2π; only available if "RAD" has been selected for the phase unit.

"-π..+π" The phase is displayed as a radian from -π to +π; only available if "RAD" has been selected for the phase unit.

"-2π..0" The phase is displayed as a radian from –2π to 0; only available if "RAD" has been selected for the phase unit.

"Infinite" The phase is displayed continuously (-∞ to +∞).

Note: The continuous phase display is mainly used for frequency sweeps, to allow the phase characteristic to be displayed even in the case of phase displacement above 360°. This measuring mode is usually unsuitable for measurements without frequency variation since such measurements do not have a valid previous value.

The continuous phase is measured by adding the phase difference between two consecutive phase measurement results to the phase measured value of the first measurement result:

$$\varphi_2 = \varphi_1 + \Delta\varphi$$

where

$$\Delta\varphi = \varphi_{2mes} - \varphi_{1mes}$$

When configuring a frequency sweep for measuring the continuous phase, the frequency step size and the number of sweep points must be selected such that no phase shifts of more than 180° occur between two consecutive sweep points.

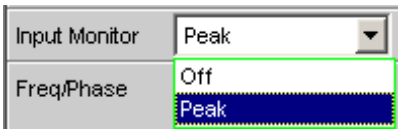
Remote command:
`SENSe3:PHASe:FORMat` on page 735

5.33 Input Monitor

The input monitor is a pure level meter that acts as a level monitor and measures the input level upstream of **all** digital filters (thus also **upstream** of the prefilter).

For other level measurement options, see chapter 5.21, "Level Measurements", on page 345, and chapter 5.34, "Level Monitor", on page 434.

Input Monitor
Used to activate the input level meter and to select the measurement method.



"Off" The "Input Monitor " is switched off.

"Peak" The peak input value is measured. The numerically highest input sample is determined within a preset interval.

Note: In contrast to peak measurement, which – like all measuring functions – takes place downstream of the filters, no interpolation filter (oversampling filter) is used.

Remote command:
SENSe2:FUNCtion `OFF | IPEak`

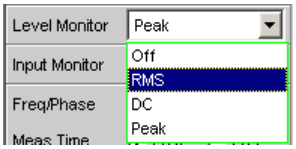
5.34 Level Monitor

The level monitor is a level meter which is used to determine the level downstream of the prefilter but upstream of the function-specific digital filters.

For other level measurement options, see chapter 5.21, "Level Measurements", on page 345 and chapter 5.33, "Input Monitor", on page 433.

The level monitor works with period detection and measures the input signal – starting at the zero crossing – across a complete period, but at least with 100 samples. With function measurements with extremely short measuring times (e.g. peak measurement with 1 ms interval time), the level monitor should therefore be switched off.

Level Monitor
Used to activate the level monitor and to select the measurement method.



"Off" The level monitor is deactivated.

"RMS" A broadband RMS measurement is performed which – with the frequency measurement switched on – uses automatic period detection. (The measurement method in this case corresponds to the "RMS measurement function " in the "Meas Time Auto mode "). With weak signals, measurement is performed over a fixed period of 100 ms. Any superimposed DC components are also measured, but (in the analog analyzer) are suppressed by the system hardware if the AC coupling is activated.

Note: In the case of multitone signals without dominant components, period detection cannot deliver reliable results; in this case, the RMS result exhibits slightly larger fluctuations.

"DC" A DC voltage measurement with automatic AC suppression is performed. With weak signals, measurement is performed over a fixed period of 100 ms.
In the analog analyzer, DC coupling should be selected for this measurement mode because the DC component of the measurement signal is filtered out with AC coupling. A suitable warning will be displayed if the coupling is switched to AC with DC measurement enabled, or if the mode is switched to DC measurement with AC coupling selected; however, the measurement is performed.

Note: In the case of multitone signals without dominant components, AC period detection cannot deliver reliable results; in this case, the DC result exhibits slightly larger fluctuations.

"Peak" A measurement of the input peak value is performed. The numerically highest input same is determined within a predefined time interval that is also obtained from the period length of the measurement signal. With weak signals, measurement is performed over a fixed period of 100 ms.

Note: In contrast to peak measurement, which – like all measuring functions – takes place downstream of the filters, no interpolation filter (oversampling filter) is used.

Remote command:
SENSe6:FUNCtion `OFF | LRMS | DC | PEAK`

5.35 Settling Methods

5.35.1 Applications

Every signal that is output by the R&S UPP generator passes through several delay elements until it returns via the "DUT " to the measurement hardware of the R&S UPP analyzer. The delay times must be taken into account in order to prevent a new measurement being started – after a signal change – before the new signal becomes visible on the analyzer. The total measurement time, therefore, is made up of the actual measurement time and the delay time.

The internal delays of the R&S UPP are known and taken into account automatically on starting a measurement. The instrument delays are in the range of a few milliseconds, depending on the sampling rate. What may actually cause problems are delays and settling times that occur in the "DUT " and, possibly, also on the transmission lines from the generator to the "DUT " and from the "DUT " to the analyzer.

If they are **known** and **constant** for all signal changes that occur, the total delay may be entered as "Start Condition Delay" and then acts as a waiting time before the measurement starts – just like the internal delays.

If external delays and settling times are **known but not constant**, the worst-case value can be entered as the delay. In the case of most measurements, however, this will unduly extend total measurement time, especially where the actual measurement time is significantly shorter than the waiting time. Conditions are particularly difficult if external waiting or settling times are **unknown**, or if an external signal source is used.

For all of these cases it would be preferable to determine – by way of measurement – the time at which the DUT settled, and only then to carry out the desired measurement.

The purpose of the settling method described here is to determine the settling time by means of a measurement. The basic idea is to perform as many measurements as possible while settling is still in progress and to determine the time at which the signal has settled to an extent that the measured value can be regarded as stable. This time is determined based on the – continuously decreasing – difference between successive measured values.

The settling method is particularly reliable when combined with a trigger condition, as with an external sweep or an external level trigger. In such cases, the trigger condition is not fulfilled until a signal change is detected in the measured value and stabilizes over several measurements.

If there is no such trigger condition (such as with manually started single measurements), in the case of very long delays or very short measurement times it may happen that the desired number of measurements is completed before the signal change becomes visible on the analyzer.

With manually started single measurements, therefore, the external signal delay should be entered as exactly as possible as "Delay" under "Start Condition", while the settling method is activated as well.

- The external signal delay is entered as a fixed delay under "Start Condition".
- The settling time is dynamically measured with the settling method.

The following types of settling can be activated and also combined with one another as desired (i.e. several types of settling can be used simultaneously):

- Settling in the "Start Condition" menu, i.e. with an external level or frequency sweep or with an external level trigger. An additional delay is not required.
- Function settling in the case of distortion measurements and (most) level measurements. As the measurement time becomes shorter relative to the signal delay, it becomes more important to compensate for the signal delay.
- Frequency Settling (not for multichannel analyzers)
- Phase Settling (not for multichannel analyzers)

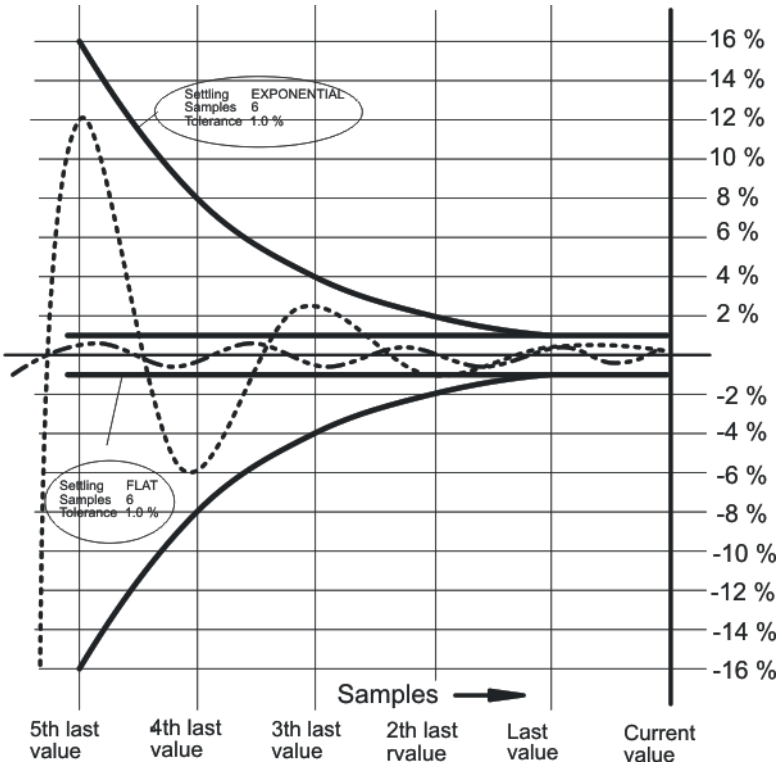
5.35.2 Settling Algorithms

The R&S UPP offers two different settling algorithms. As a feature common to both algorithms, each current measured value is compared to up to five of the immediately preceding measured values and is accepted as valid only if the differences between the current value and the preceding values are within specified tolerances.

In addition, an averaging function is available in order to reduce measured-value variations.

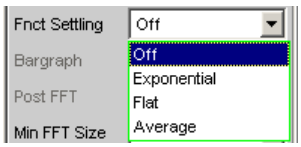
"Flat Settling" employs a tolerance mask with a completely flat characteristic (tolerance "band") whose capture range is determined by fixed tolerance limits. In the case of very small tolerance values, this algorithm yields a measurement result only after the DUT settles almost completely.

"Exponential Settling" uses a tolerance mask with an exponential characteristic (tolerance "funnel ") whose capture range enlarges toward the earlier measured values, i.e. larger deviations are tolerated for the earlier values. This algorithm is suitable for level and distortion measurements, where most DUTs likewise exhibit an exponential settling characteristic.



5.35.3 Settling for Measurement Functions

Fnct Settling
Used to activate the settling measurement for results of measurement functions and to select the settling method.



Results of measurement functions are not valid until the selected settling condition is fulfilled.

With the S/N measurement function and with level measurement functions in the S/N mode, the instrument determines the settling times separately for the useful signal plus noise and for the noise signal only. This yields two level values, of which the signal-to-noise quotient is formed.

Function Settling is available for most level measurement functions (except rub & buzz) and for distortion measurements.

The following applies to settling measurements, irrespective of the selected unit:

- With level measurements, the settling measurement is based on the results in volts (analog) or FS (digital).
- With distortion measurements, the settling measurement is based on the results in %.

Note: For the FFT measurement function, averaging of FFT data is available instead of a settling measurement, which is possible for measured values only (see section "Avg Mode " on page 404).

"Off" Function Settling is switched off. The measurement time is very short, since only a single measurement is performed.

This setting is recommended if the DUT settling time

- can be ignored.
- is known and taken into account by entering a fixed delay.

"Exponential" Function Settling is switched on and the exponential method is employed. Since several measurements have to be performed, the measurement time is considerably longer than if Function Settling is switched off.

This setting is recommended if the DUT settling time cannot be taken into account by entering a fixed delay because

- it is not known.
- it is not constant.

"Flat" Function Settling is switched on and the flat method is employed. All measurement samples should occur within a tolerance band of uniform width. This method, therefore, usually requires a higher number of measurements than the (softer) exponential method.
This setting is recommended if it must be ensured that the results of several successive measurements are settled.

"Average" The arithmetic average of a selectable number of successive results (obtained with a measurement function) is formed.
This setting is recommended in order to compensate for measured-value variations. Where possible, the DUT settling time should additionally be taken into account by entering a corresponding delay under "Start Condition".

Remote command:
SENSe<n1>:FUNCtion:SETTling:MODE on page 736

Samples
Designates the number of measured values to be covered by the settling algorithm, i.e. it defines how many measured values are to be used in the settling measurement or for averaging.

Note: In this exceptional case, the term "sample" is used to designate an internal measurement result instead of a digital sample.

Remote command:
SENSe<n1>:FUNCtion:SETTling:COUNt on page 735

Tolerance
The tolerance value designates the maximum permissible value by which the current measured value may differ from the preceding measured values so that it is still classified as settled.

With exponential settling, the selected tolerance value applies only to the difference between the current and the last preceding measured value; for each earlier measured value, the tolerance value increases by a factor of 2.

Remote command:
SENSe<n1>:FUNCtion:SETTling:TOLerance on page 736

Resolution
The resolution value designates the maximum permissible absolute value by which the current measured value may differ from the preceding measured values in order to be accepted as settled, although the tolerance condition may be violated. This means that a measured value is regarded as not settled only if it fails to meet both the tolerance and the resolution condition.

With exponential settling, the selected resolution value applies only to the difference between the current and the last preceding measured value; for each earlier measured value, the resolution value increases by a factor of 2.

Remote command:
SENSe<n1>:FUNCtion:SETTling:RESolution on page 736

Timeout
Defines the maximum time that a settling algorithm is allowed to detect a settled result after the start of a measurement.

If no stable measured value is detected during this time, the measurement is aborted. An invalid result is output in the numeric and the sweep display and also via the remote line.

Defining a timeout is important especially with "true" settling methods, because, with these methods, a settled value may never be detected if tolerance limits are too narrow. If averaging is employed, on the other hand, the number of measurements, and thus the measurement time, are finite and the timeout may be deactivated, as it were (by entering the maximum value of 2000 s).

Note: If a multichannel analyzer is used, max. 1.44 million samples can be monitored. In these analyzers, the maximum timeout is therefore dependent on the sampling rate and the analog bandwidth; at 40 kHz analog bandwidth, for example, it is 15 s.

Remote command:
`SENSe<n1>:FUNCtion:SETTling:TOUT` on page 0

5.35.4 Settling for Start Conditions (Event-Triggered Measurements)

The settling procedure can also be applied to all event-triggered measurements – i.e. measurements that are measured-value-triggered rather than time-triggered.

With external sweeps, the value of a measured parameter never changes simultaneously with the start of the frequency or level measurement that monitors the measured parameter for changes. In the event of a value change, therefore, the monitoring routine usually does not measure the new frequency or level value but an intermediate value, i.e. a value between the old and the new value. If the trigger threshold (variation) is smaller than the actual value change, it may happen that even the measured intermediate value triggers the next measurement in a sweep. This does not produce a falsified result (Y value of the sweep display) since the next measurement is not started until the signal change is detected. However, the sweep parameter (X value of the sweep display) that triggers the next measurement is too close to the preceding X value.

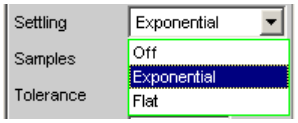
To ensure that the X values of an external sweep are also measured with great accuracy, the settling procedure should be applied to external sweeps as well.

Due to a frequency change, some DUTs take a long time until the level has settled (e.g. hearing aids with a sound level limiter or compander/expander circuits with short level rise times and long decay times). With such DUTs, therefore, it is not sufficient to apply the settling procedure to the trigger routine only. In addition, then, a start delay or Function Settling should be activated.

Timeout monitoring is not meaningful in settling procedures applied to event triggers (i.e. not time triggers), since it takes an indefinite period of time until the external event triggering a measurement occurs, and an early abortion of the monitoring routine would be of no avail.

If a multichannel analyzer is used, max. 1.44 million samples can be monitored. In these analyzers, the maximum measuring time for detecting (and settling to) the external trigger condition is therefore dependent on the sampling rate and the analog bandwidth; at 40 kHz analog bandwidth, for example, it is 15 s.

Settling
Used to activate the settling measurement for the frequency/level monitoring routine in the case of external sweeps and external level/edge triggering, and to select the "settling " method.



Results of trigger signal measurements are valid only if the selected "settling "condition is fulfilled.

The following applies to settling measurements, irrespective of the selected unit:

- With external level sweeps and external level/edge triggering, the settling measurement is based on the results of the trigger signal measurement in volts (analog) or FS (digital).
- With external frequency sweeps, the settling measurement is based on the results of the trigger signal measurement in Hz.

Note: Averaging the results of trigger signal measurements would not provide conclusive information and is therefore not implemented.

"Off" The frequency/level monitoring routine is performed without the settling function. This setting offers the shortest possible response time to a detected signal change. It is not sure, however, whether the nominal trigger value (X value of the sweep display) is actually attained.

"Exponential" The settling function is switched on for the frequency/level monitoring routine, and the exponential method is employed. Since several measurements have to be performed, the response time to the detected signal change becomes longer.
This setting is recommended for external level sweeps and external level/edge triggering since most DUTs exhibit an exponential level settling characteristic.

"Flat" The settling function is switched on for the frequency/level monitoring routine, and the flat method is employed. Since several measurements have to be performed, the response time to the detected signal change becomes longer.
This setting is recommended for external frequency sweeps if the actual trigger value (X value of the sweep display) is to be determined very accurately. In the event of a frequency change, the DUT will usually yield a maximum of only one invalid intermediate frequency value. Therefore it is sufficient to set the number of samples to a value of "2", so that only two or three measurements of the trigger signal are performed.

Remote command:
`SENSe<n1>:TRIGger:SETTling:MODE` on page 736

Samples
Designates the number of measured values to be covered by the settling algorithm, i.e. it defines how many frequency or level measured values are to be used for settling.

With "n" samples set, expect the following number of trigger-value measurements:
- With frequency triggering and flat settling: n or n+1
- With level triggering and exponential settling: > n

Note: In this exceptional case, the term "sample" is used to designate an internal measurement result instead of a digital sample.

Remote command:
`SENSe<n1>:TRIGger:SETTling:COUNt` on page 735

Tolerance
The tolerance value designates the maximum permissible value by which the current trigger value may differ from the preceding trigger values so that it is still classified as settled.

With exponential settling, the selected tolerance value applies only to the difference between the current and the last preceding trigger value; for each earlier trigger value, the tolerance value increases by a factor of 2.

Remote command:
`SENSe<n1>:TRIGger:SETTling:TOLerance` on page 736

Resolution
The "Resolution " value designates the maximum permissible absolute value by which the current trigger value may differ from the preceding trigger values in order to be accepted as settled, although the tolerance condition may be violated. This means that a trigger value is regarded as not settled only if it fails to meet both the tolerance and the resolution condition.

Fig. 5-13: (for external frequency sweeps)

Fig. 5-14: (for external digital level sweeps)

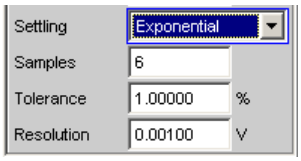
Fig. 5-15: (for external analog level sweeps)

With exponential settling, the selected resolution value applies only to the difference between the current and the last preceding trigger value; for each earlier measured value, the resolution value increases by a factor of 2.

Remote command:
`SENSe<n1>:TRIGger:SETTling:RESolution` on page 736

5.35.5 Examples of Settling

The examples below are based on the following settings:



With the above settings, the current measured value may deviate:

- from the last measured value by a max. of +/- 1% (or +/- 0.086 dB),
- from the 2nd-last measured value by a max. of +/- 2 % (or +/- 0.172 dB),
- from the 3rd-last measured value by a max. of +/- 4 % (or +/- 0.340 dB),
- from the 4th-last measured value by a max. of +/- 8 % (or +/- 0.668 dB),
- from the 5th-last measured value by a max. of +/- 16% (or +/- 1.289 dB)

For an analog level measurement with a result of 1 V this means that

- the last measured value must be between 0.99 and 1.01 V.
- the 2nd last measured value must be between 0.98 and 1.02 V.
- the 3rd last measured value must be between 0.96 and 1.04 V.
- the 4th last measured value must be between 0.92 and 1.08 V.
- the 5th last measured value must be between 0.84 and 1.16 V

.

For a distortion measurement with a result of 0.01% this means that

- the last measured value must be between 0.0099 and 0.0101%
- the 2nd-last measured value must be between 0.0098 and 0.0102%

- the 3rd-last measured value must be between 0.0096 and 0.0104%
- the 4th-last measured value must be between 0.0092 and 0.0108%
- the 5th-last measured value must be between 0.0084 and 0.0116%

in settled state.

5.36 Filter

This section describes the describes the settling options for the filter, see chapter 5.37, "User-Definable Filters", on page 446, and chapter 5.38, "Weighting Filters", on page 454.

The user-definable filters are configured in the Filter panel. They can then be used in the analyzer as prefilters and function filters and also in the generator.

The weighting filters and the fixed highpass and lowpass filters are not selected in the Filter panel. They are selected together with the user-configurable filters in the selection fields of the analyzer and generator.

Here, there is an overview of the filters which can be set up in the analyzer and generator, together with the remote-control parameters, see chapter 5.36.4, "Filter Table", on page 446.

5.36.1 Analyzer Prefilter

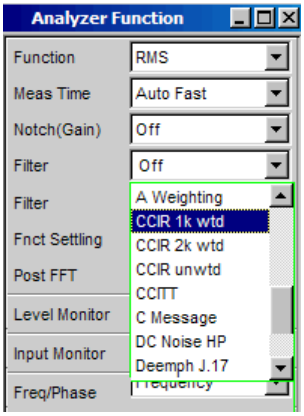
A filter which influences all measurement functions can be selected in the Analyzer Config panel. One of the user-definable filters in the Filter Panel or a weighting filter can be selected. This means that prefiltering is possible without having to select the required filter for every single measurement function.

SCPI command:

INPut:FILTer CMES, page 737

5.36.2 Analyzer Function Filters

In the Analyzer Function panel, up to 2 of the user-definable filters in the Filter panel or weighting filters can be looped into the measurement path regardless of which level measurement method is selected.



5.36.3 Generator Filters

Most of the generator signals can be filtered in the time domain. A user-defined filter, a weighting filter, or a highpass or lowpass filter can be selected in the Function panel.

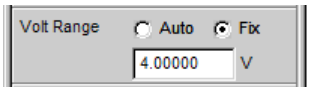
Remote-control command: `SOURce:FILTer` on page 740

If a filter with gain is used (such as the "CCIR 1k wtd" weighting filter), the generator signal level must be selected as described below in such a way that overranging cannot occur with the maximum filter gain.

Analog generator:

In the Generator Config panel, set "Voltage Range" to "Fix", and in the Generator Function, panel set the level low enough to ensure that the amplified level will always be less than the selected fixed voltage range.

Example:



Here the maximum allowable gain of the filter is 4 (12 dB).

Digital generator:

Select a level that is low enough to ensure that the level plus the maximum gain of the filter will always be less than the full-scale level.

With both types of generator (analog and digital), any DC offset that has been configured must be taken into account when setting the level.

5.36.4 Filter Table

The overview of the filters which can be set up in the analyzer and generator, together with the remote-control parameters, is located under the description of the commands, see `INPut<n1>:FILTer` on page 737.

5.37 User-Definable Filters

In the Filter panel, 9 filters (defined as Filter 01 to Filter 09) can be defined individually as lowpass filters, highpass filters, bandpass filters, bandstop filters, notch filters, third-octave filters or octave filters.

These filters are implemented as recursive, elliptical eighth-order digital filters (exception: fourth order is also possible for lowpass and highpass filters). All filters are calculated by means of frequency transformation from a database with standardized reference lowpass filters. The ripple in the passband is 0.1 dB; stopband attenuation is available in steps of approx. 10 dB.

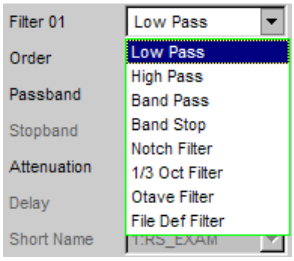
The user only has to enter the passband and the minimum stopband attenuation. The frequencies of the stopband are calculated and displayed taking the required stopband attenuation into consideration. The implemented stopband attenuation is always equal to or greater than the specified value.

Apart from the parameters entered in the Filter panel, the sampling rate must also be known to allow calculation of the filter. The other parameters (stop frequency, delay and the attenuation actually implemented) can therefore only be calculated and displayed after the filter has been activated in the analyzer or generator.

5.37.1 Filters 01 to 09

Selection of the filter type for the filters 1 to 9.

Filters 01 to 09



Remote command:
`SENSe<n1>:UFILter<n2>` on page 738

5.37.2 Lowpass Filter and Highpass Filter

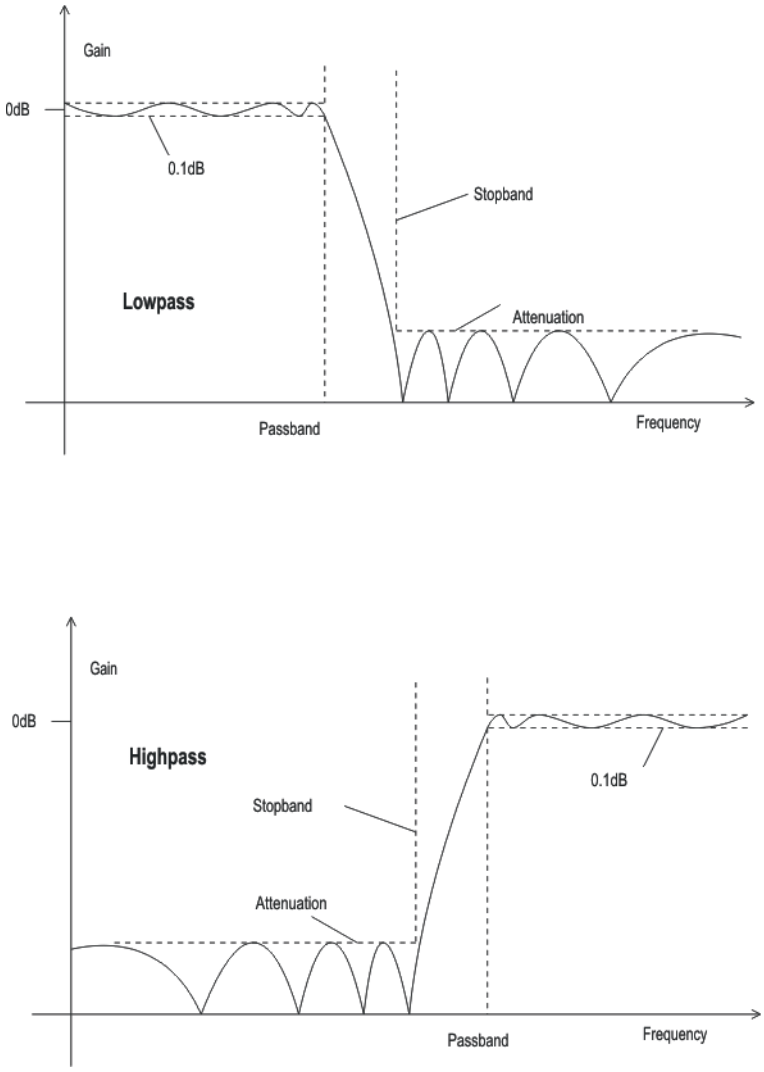


Fig. 5-16: Lowpass and highpass frequency response with filter parameters

Order
Used to specify the filter order. Only available for lowpass and highpass filters. Low-order filters have edges with a lower rate of rise, but settle more quickly.

"4" 4th Order Filter

"8" 8th Order Filter

Remote command:
`SENSe<n1>:UFILter<n2>:ORDer` on page 739

Passband
Used to specify the corner frequency (- 0.1 dB) of the passband in lowpass and high-pass filters

Remote command:
SENSe<n1>:UFILter<n2>:PASSb on page 739

Stopband
Displays the cutoff frequency of the stopband in the case of lowpass and highpass filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote command:
SENSe<n1>:UFILter<n2>:STOPb on page 739

5.37.3 Bandpass Filters and Bandstop Filters

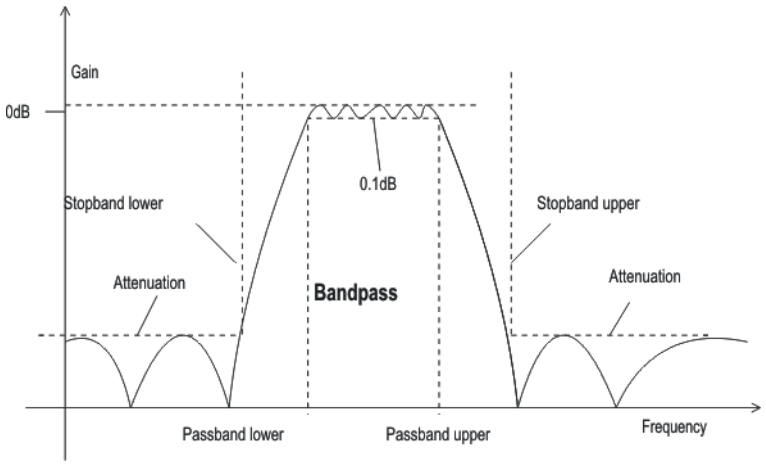


Fig. 5-17: Bandpass frequency response with filter parameters

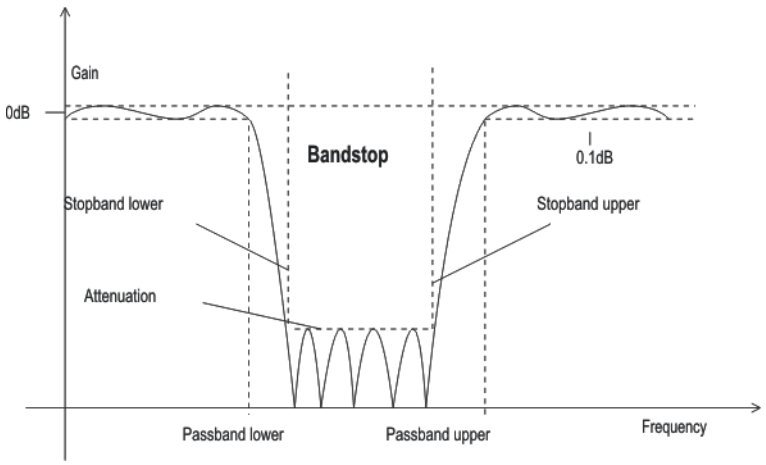


Fig. 5-18: Bandstop frequency response with filter parameters

Passb Low
Used to specify the lower corner frequency (- 0.1 dB) of the passband for bandpass or bandstop filters.

Remote command:
SENSe<n1>:UFILter<n2>:PASSb:LOWer on page 739

Passb Upp
Used to specify the lower corner frequency (- 0.1 dB) of the passband for bandpass or bandstop filters.

Remote command:
SENSe<n1>:UFILter<n2>:PASSb:UPPer on page 739

Stopb Low
Displays the lower cutoff frequency of the stopband in the case of bandpass and bandstop filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote command:
SENSe<n1>:UFILter<n2>:STOPb:LOWer on page 739

Stopb Upp
Displays the upper cutoff frequency of the stopband in the case of bandpass and bandstop filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote command:
SENSe<n1>:UFILter<n2>:STOPb:UPPer on page 739

5.37.4 Notch Filter, Third-Octave Filter and Octave Filter

Third-octave and octave filters are bandpass filters whose passband is geometrically symmetrical to the center frequency, whereby the passband frequencies are derived from the center frequency as follows:

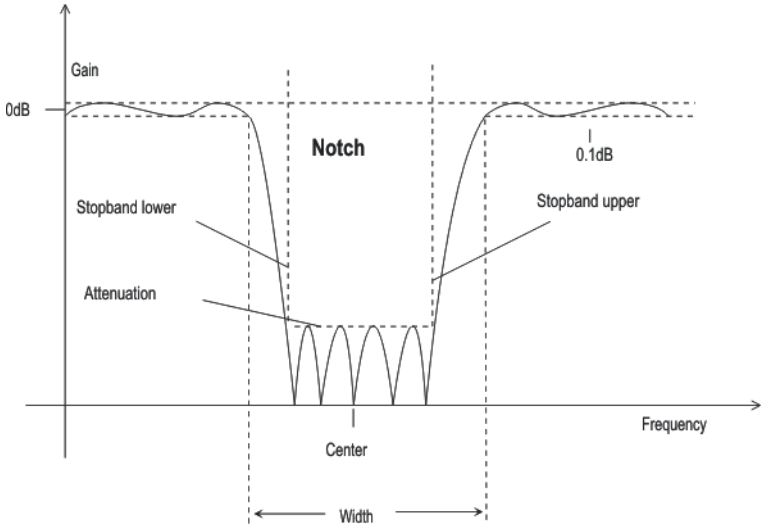


Fig. 5-19: Notch filter frequency response with designation of the filter parameters

Third-octave filter:	$\text{Passband low} = CenterFreq / \sqrt[6]{2}$
	$\text{Passband upp} = CenterFreq \times \sqrt[6]{2}$
	$\text{Bandwidth} = \sqrt[6]{2} - \left(1/\sqrt[6]{2}\right) = 0.2315 = 23.15\%$
Octave filter:	$\text{Passband low} = CenterFreq / \sqrt{2}$
	$\text{Passband upp} = CenterFreq \times \sqrt{2}$
	$\text{Bandwidth} = \sqrt{2} - \left(1/\sqrt{2}\right) = 0.7071 = 70.71\%$

With the third-octave and octave filters, the 0.1 dB bandwidth is reduced until an attenuation of approx. 3 dB is obtained for the cutoff frequencies. The displayed numeric value for "Width" is therefore less than the 3 dB bandwidth of the third-octave and octave filter.

Center Freq
Used to specify the center frequency. The notch filter has a transmission zero at the center frequency; the attenuation at this frequency is considerably greater than the specified stopband attenuation.

Remote command:
`SENSe<n1>:UFILter<n2>:CENTer` on page 738

Width
For notch filter: used to specify the difference between the upper and lower cutoff frequency (- 0.1 dB) of the passband.

For third-octave and octave filter: displays the width of the passband.

Remote command:
`SENSe<n1>:UFILter<n2>:WIDTh` on page 740

Stopb Low
Displays the lower cutoff frequency of the stopband; the cutoff frequency is derived from the selected passband and the stopband attenuation (only for the notch filter). This value is only updated after the filter is activated.

Remote command:
`SENSe<n1>:UFILter<n2>:STOPb:LOWer` on page 739

Stopb Upp
Displays the upper cutoff frequency of the stopband; the cutoff frequency is derived from the selected passband and the stopband attenuation (only for the notch filter). This value is only updated after the filter is activated.

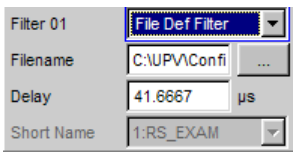
Remote command:
`SENSe<n1>:UFILter<n2>:STOPb:UPPer` on page 739

5.37.5 File-Defined Filter

If the filters installed on the instrument do not satisfy the requirements of the application concerned, it is possible to read in a filter from a file. Two file formats are supported in which the filter is described either by the coefficients of the transfer function (`*.coe`) or by the poles and zeros (`*.zpz` or `*.npz` and `*.xpz`) in the z level.

5.37.5.1 File Def Filter

File Def Filter



A file can be loaded in which the filter is described either by the coefficients of the transfer function (`*.coe`) or by the poles and zeros (`*.zpz` or `*.npz` and `*.xpz`) in the z level.

The ... button opens a browser that can be used to select the filter file.

Remote command:
`SENSe<n1>:UFILter<n2>:FNAMe` on page 738

5.37.5.2 Coefficients of the transfer function

The filter in the file must be an IIR filter with four pairs of poles and zeros in the form of four consecutive biquads.

The transfer function S(z) is then derived as follows:

$$S(z) = gain \cdot \frac{\prod_{i=0}^{3} z^2 + z \cdot b1i + b2i}{\prod_{i=0}^{3} z^2 - z \cdot a1i - a2i}$$

Example:

See `RS_EXAM.COE` in `D:\UPV\USER`

The coefficient file `*.COE` is only valid for the sampling rate determined during the design stage, i.e. the frequency response of the filter is standardized to this sampling rate. If a different sampling rate is set in the R&S UPP, the frequency response changes accordingly.

5.37.5.3 Poles and zeros of the transfer function

The filter is defined by specifying the poles and zeros on the Z level. Four pairs of poles and zeros are permitted. Unused poles and zeros must be placed at the origin of the Z level.

The transfer function S(z) is then derived as follows:

$$S(z) = gain \cdot \frac{\prod_{i=0}^{3} (Z - Zoi)(Z - Zoi^*)}{\prod_{i=0}^{3} (Z - Zpi)(Z - Zpi^*)}$$

where: z0 = zeros, zp = poles, z* = conjugate complex number. (5 - 5)

File format *.zpz

Example:

See `RS_EXAM.ZPZ` in `D:\UPV\USER`

The `*.ZPZ` poles/zeros file is only valid for the sampling rate determined during the design stage, i.e. the frequency response of the filter is standardized to this sampling rate. If a different sampling rate is set in the R&S UPP, the frequency response changes accordingly.

File format *.npz

Example:

See the `RS_EXAM.NPZ` file in the `D:\UPV\USER` directory

Poles and zeros in the `*.NPZ` are standardized to the sampling frequency specified there. If a different sampling rate is set in the R&S UPP poles and zeros are converted to this rate so that the frequency response of the filter remains unchanged. A reference point for the frequency response, defined in terms of a reference frequency and the reference gain at this frequency, must be specified in the file.

File format *.xpz

This file format is an extension of the "npz" format. The file can contain multiple parameter sets for the pole and zero locations. For each parameter set, the associated sampling frequency must be specified, along with the sampling frequency range within which the pole and zero locations can be transformed such that the frequency response of the filter remains within the specified tolerance. This file format allows filters with tight tolerances to be used over a wide range of sampling frequencies.

Poles and zeros in the `*.XPZ` file are normalized to the sampling frequencies specified for the individual parameter sets. If a different sampling rate is configured in the R&S UPP, the pole and zero locations in the allowable frequency range are transformed to correspond to the actual sampling frequency so the frequency response of the filter remains unchanged. A reference point for the frequency response, defined in terms of a reference frequency and the reference gain at this frequency, must be specified in the file.

5.37.6 Parameters Common to All Filters

Attenuation
Used to specify the desired filter attenuation of the stopband in dB. When the filter is activated, the attenuation actually implemented must be entered here (this attenuation is normally greater than the entered value). Filter attenuation in steps of approx. 10 dB is possible.

Remote command:
`SENSe<n1>:UFILter<n2>:ATTenuation` on page 738

Delay
Displays the estimated settling time of the filter. This value is only updated after the filter is activated.

Exception: With file-defined filters, a settling time is calculated and displayed after the coefficients are read in. This settling time can then be changed manually.

Remote command:
`SENSe<n1>:UFILter<n2>:DELay` on page 738

Short Name
Displays a short name under which the filter can be called up in the analyzer or generator. The short name consists of the filter type code (2 letters) and the frequency. (LP = lowpass filter, HP = highpass filter, BP = bandpass filter, BS = bandstop filter, TZ = third-octave filter, OC = octave filter, NO = notch filter).

The name of the file is shown here in the case of file-defined filters.

5.37.7 Filter Settling Time

The settling time of the filter can be estimated from the filter parameters. Certain filters (e.g. filters with steep edges and narrowband bandpass filters) have longer settling times.

When measurement is started (e.g. by making new settings, pressing the start key or in the case of a sweep), the R&S UPP waits until this settling time expires for every filter before performing the actual signal integration. If (in exceptional cases) the calculated time is too short, the filters cannot settle properly before the measurement is started. This can result in unstable measured values.

The following trick can be used to remedy this problem:

If the `DELAY.COE` file-defined filter (in the `D:\UPV\USER` directory) is selected, a settling time can be entered there, which is added to the settling time of the other filters when measurement is performed. The `DELAY.COE` filter has no other function.

If a multichannel analyzer is used, the total settling time of all activated analyzer filters is limited to 150 000 samples (at 40 kHz analog bandwidth, this corresponds to a settling time of approx. 1.5 s). If this is not long enough (e.g. if four very steep-edged filters are used), an additional delay may be entered under "Start Condition".

With continuous measurement, the filter settling time is added only with the (re)start of the first measurement. All further measurements in this case are performed without delay.

If a multichannel analyzer is used, the signal is not monitored continuously during continuous measurement; the filter settling time is therefore added with each subsequent measurement as well.

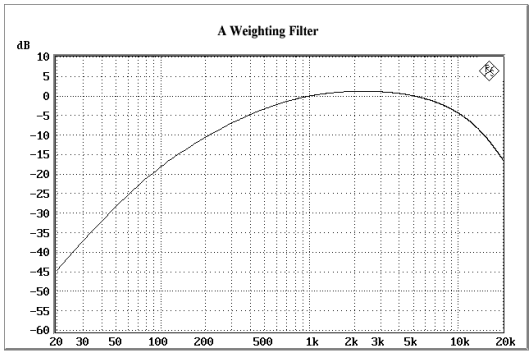
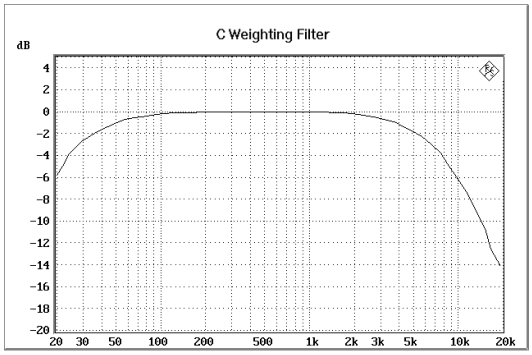
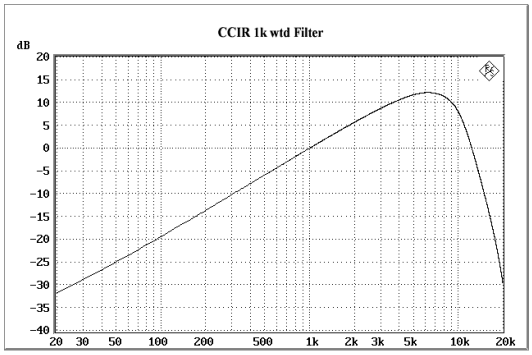
5.38 Weighting Filters

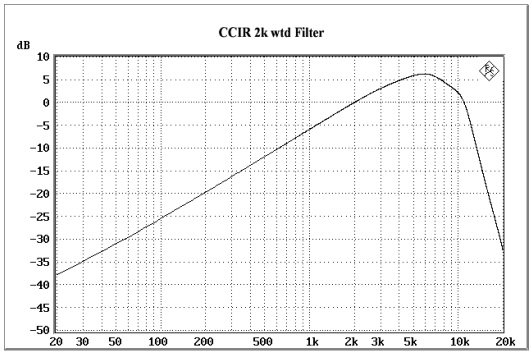
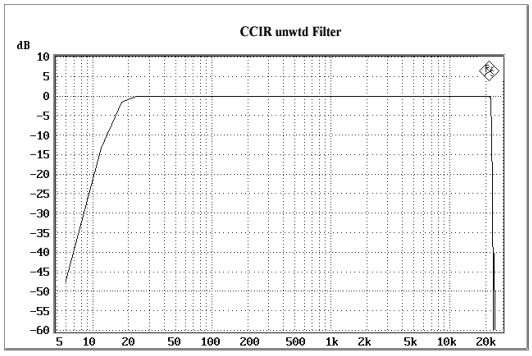
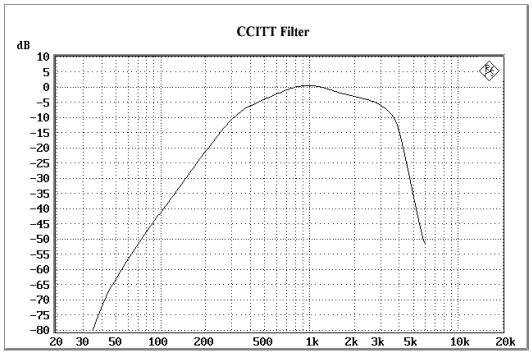
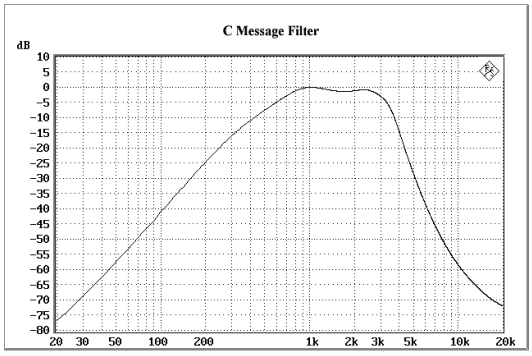
In addition to the user-definable filters, the R&S UPP also offers a large number of weighting filters which conform to the relevant standards.

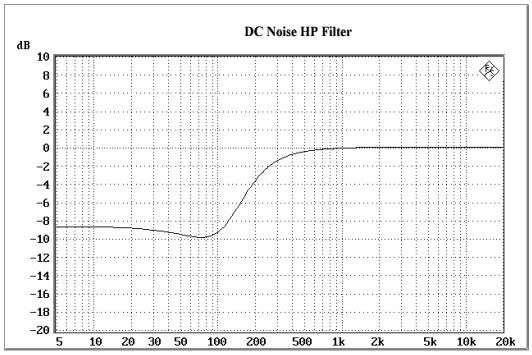
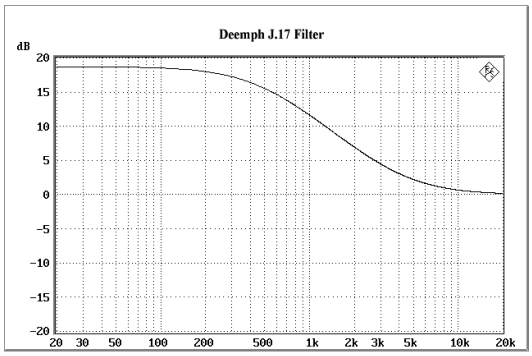
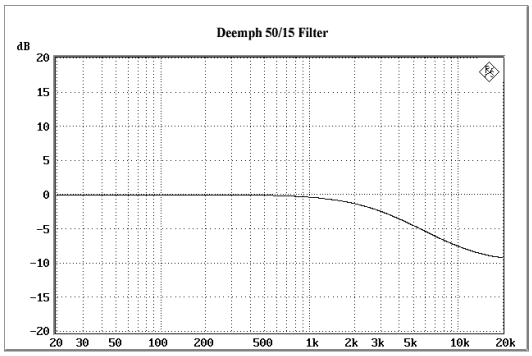
The weighting filters and the fixed highpass and lowpass filters are not selected in the Filter panel. They are selected together with the user-configurable filters in the selection fields of the analyzer and generator.

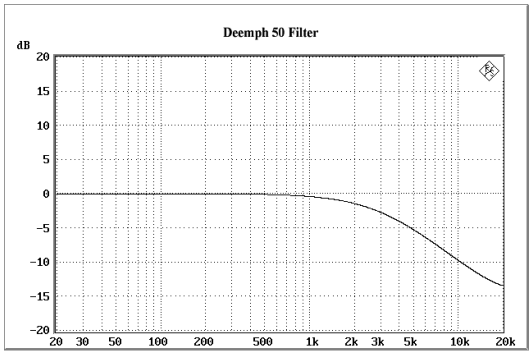
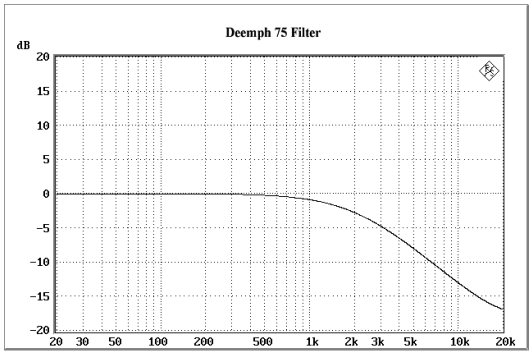
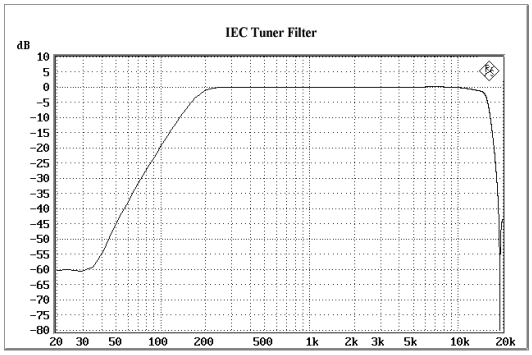
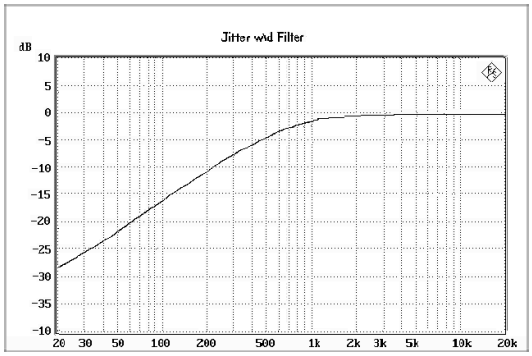
Remote-control command:

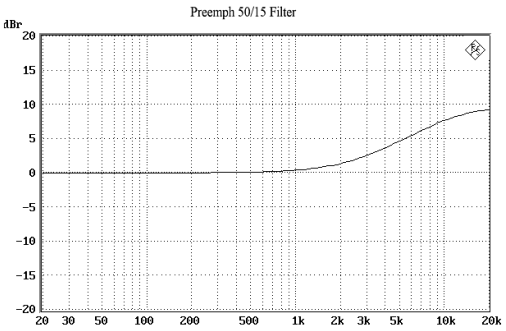
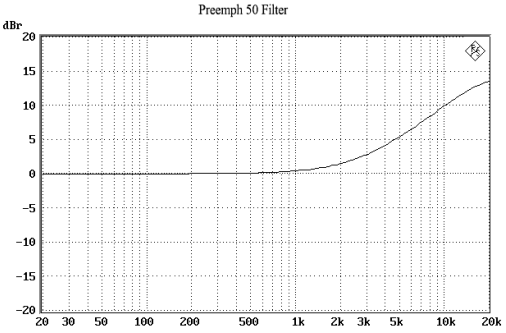
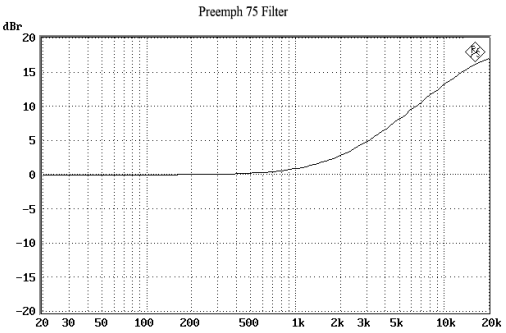
INPut<n1>:FILTer on page 737

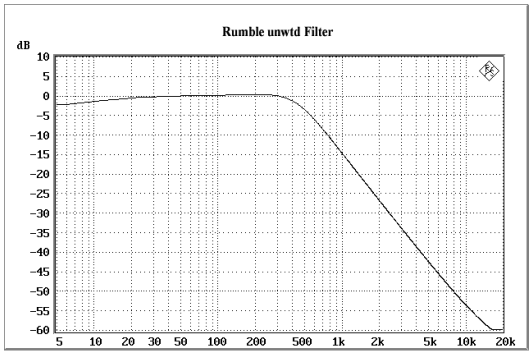
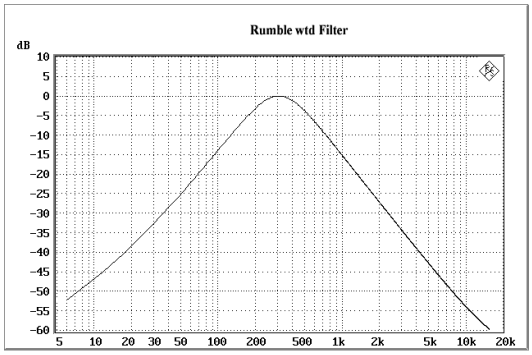
Filters:	A Weighting	
Standards:	DIN 45412, DIN 45633 IEC 179, IEC 651 ANSI S1.4	
Application:	Weighted noise measurement	
Filters:	C Weighting	
Standards:	IEC 179, IEC 651 ANSI S1.4	
Application:	Weighted noise measurement	
Filters:	CCIR 1k wtd	
Standards:	Standards: CCIR Rec. 468-4 DIN 45405 CCITT Rec. N21 CISPR 6-76 ITU-T J.16	
Application:	Weighted noise measurement	

Filters:	CCIR 2k wtd	
Standards:	Dolby	
Application:	NAB standard	
Filters:	CCIR unwtd	
Standards:	Standards: CCIR Rec. 468-4 ITU-T J.16	
Application:	Bandpass from 20 Hz to 20 kHz for band-limited unweighted measurement to CCIR	
Filters:	CCITT	
Standards:	Standards: ITU-T Rec. O. 41 CISPR 6-76 ITU-T Rec. P.53	
Application:	Psophometric weighting	
Filters:	C Message	
Standards:	IEEE 743-1995	
Application:	Weighted noise measure-ment	

Filters:	DC Noise HP	
Standards:	Standard: ARD Spec. 3/4 ARD Spec. 12/2	
Application:	Highpass filter for measurement of DC noise (tape recorders)	
Filters:	Deemph J.17	
Standards:	ITU-T J.17	
Application:	Weighted noise measurement	
Filters:	Deemph 50/15	
Standards:	CCIR Rec. 651	
Application:	Compact disc	

Filters:	Deemph 50	
Standards:	ARD Spec. 5/3.1	
Application:	Weighted noise measurement	
Filters:	Deemph 75	
Standards:	ARD Spec. 5/3.1	
Application:	Weighted noise measurement	
Filters:	IEC Tuner	
Standards:	DIN/IEC 60315-4	
Application:	Measurements on FM tuners	
Filters:	Jitter wtd	
Standards:	AES 3	
Application:	Application: Weighting of jitter transfer function 1st order HP -3 dB at 700 Hz -20 dB at 70 Hz	

Filters:	Preemph 50/15	
Standards:	CCIR Rec. 651	
Application:	Compact disc	
Filters:	Preemph 50	
Standards:	ARD Spec. 5/3.1	
Application:	Weighted noise measure-ment	
Filters:	Preemph 75	
Standards:	ARD Spec. 5/3.1	
Application:	Weighted noise measure-ment	

Filters:	Rumble unwtd	
Standards:	Standards: DIN 368.3 DIN 45539	
Application:	Unweighted noise measurement	
Filters:	Rumble wtd	
Standards:	DIN 45539	
Application:	Weighted noise measurement	

5.39 Highpass and Lowpass

In addition to the user-definable filters and the weighting filters, the R&S UPP also offers a selection of preset highpass and lowpass filters.

The weighting filters and the fixed highpass and lowpass filters are not selected in the Filter panel. They are selected together with the user-configurable filters in the selection fields of the analyzer and generator.

Remote-control command: `INPut<n1>:FILTer` on page 737

HighPass 22 Hz	Highpass (3rd-order Butterworth) with 3 dB cutoff frequency at 22.4 Hz
HighPass 400 Hz	Highpass (3rd-order Butterworth) with 3 dB cutoff frequency at 400 Hz
LowPass 22 kHz	Lowpass (4th-order Butterworth) with 3 dB cutoff frequency at 22.4 kHz
LowPass 30 kHz	Lowpass (3rd-order Butterworth) with 3 dB cutoff frequency at 30 kHz

LowPass 80 kHz	Lowpass (3rd-order Butterworth) with 3 dB cutoff frequency at 80 kHz
AES 17	20 kHz lowpass (8th-order elliptic) in accordance with the AES 17 standard. Passband: ripple max. +/- 0.1 dB up to 20 kHz Stopband: attenuation > 60 dB for 24 kHz and higher

5.40 Signal Monitoring

5.40.1 Auxiliaries Panel

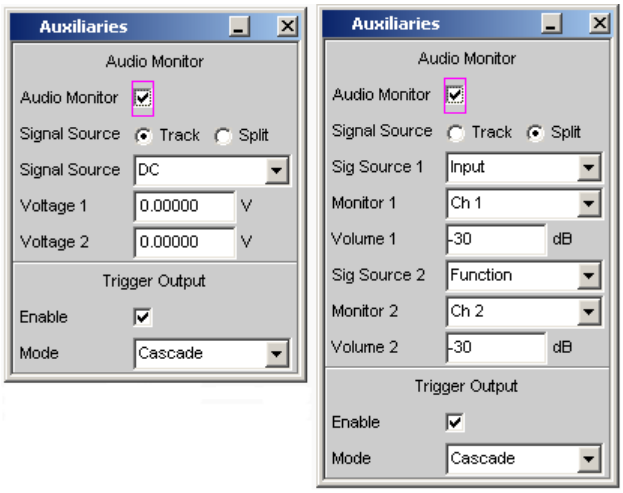
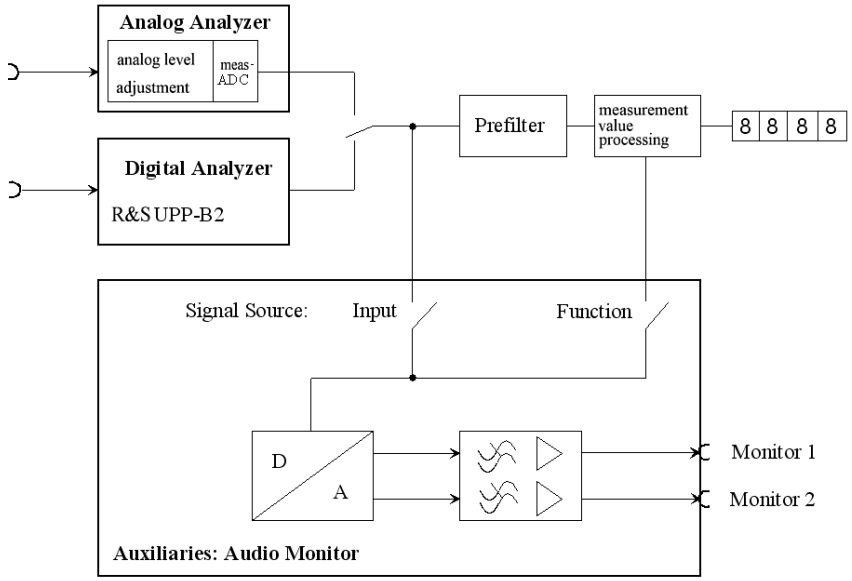


Fig. 5-20: Auxiliaries panel

In the "Auxiliaries " Panel, the additional function "Audio Monitor " can be selected.

The monitor outputs (BNC sockets on the rear panel) permit the monitoring of analog or digital input signals (referred to as "Monitoring" in this document), both directly at the Audio Analyzer input and downstream of any filters that may be active.

The block diagram below shows the points along the signal processing path at which the signal is tapped and fed to the audio monitoring output:



Audio Monitor
Activates/deactivates the monitoring function.

The monitoring signal level is adjusted in the "Volume " parameter field or by pressing CTRL+F9 on the external keypad.

The audio monitor is not available for the "HDMI" analyzer instrument in the coding = "Auto Detect" setting and is forced off after a corresponding notification if necessary.

Remote command:
`AUXiliaries:AUDMonitor` on page 741

Signal Source

The signal source ("Signal Source") and output voltage at the monitor outputs ("Volume") can be selected for both monitor outputs together ("Track") or separately from each other ("Split"). If "Split" is used, the designation for the parameter fields is supplemented by the numbers 1 or 2, e.g. "Sig Source 1" and/or "Sig Source 2". The settings for the channel assignment ("Monitor") and DC output level ("Voltage") is generally offered in two channels (i.e. it is unaffected by Signal Source Track|Split).

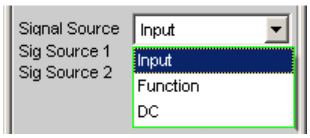
"Track" Together

"Split" Separate

Remote command:
`AUXiliaries:SIGSource` on page 741

Signal Source, Sig Source 1, Sig Source 2
Used to select the monitoring point along the signal path.

Depending on the "Signal Source" Track / Split setting, the parameter field for both monitor outputs is provided together for Monitor 1 and Monitor 2 for "Track" and separately for "Split" so that different signal sources can be set for Monitor 1 and Monitor 2.



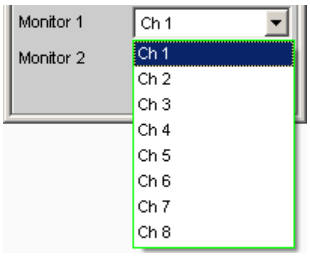
"Input" Monitoring of a signal applied at the analyzer inputs. Internally, the input signal of the activated analyzer is switched to the BNC sockets marked "Monitor" on the rear panel.

"Function" The input signal can undergo digital post-processing depending on the set measurement function and can then be monitored at the BNC sockets marked "Monitor" on the rear panel.
So as to avoid overloading in the active filter, level attenuation is carried out in the case of certain weighting filters in order to compensate for the increase in the frequency response.

"DC" Starting with serial numbers 120100, 140100, 180100, the supply of external instruments of the R&S UPP can be handled by outputting two DC voltages in the range from -5 V to +5 V which can be set independent of each other. In this case, the two monitor outputs can each output up to 50 mA.

Remote command:
AUXiliaries:SPEaker:SOURce<n3> on page 742

Monitor 1, Monitor 2
Used to select the monitored channel

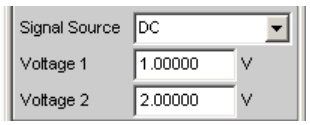


The fields "Monitor 1" and "Monitor 2" are used to select which BNC socket is assigned to which measurement channel.

These parameter fields are always provided for two channels depending on the "Signal Source" Track / Split setting.

Remote command:
AUXiliaries:SPEaker:MONitor<n3> on page 741
<n3> selects the monitor

Voltage Ch 1, Voltage Ch 2
DC voltage output for the supply of devices under test or external circuits.



Starting with serial numbers 120100, 140100, 180100, you can select in the fields "Voltage Ch 1" and "Voltage Ch 2" which DC level is output at which BNC socket at the rear of the instrument. To supply devices under test or external circuits, the R&S UPP can output two DC voltages in the range from -5 V to +5 V which can be set independent of each other. In this case, the two monitor outputs can each output up to 50 mA.

These parameter fields are always provided for two channels depending on the "Signal Source" Track / Split setting.

Remote command:
AUXiliaries:VOLTage<n2> on page 742
<n2> selects the monitor

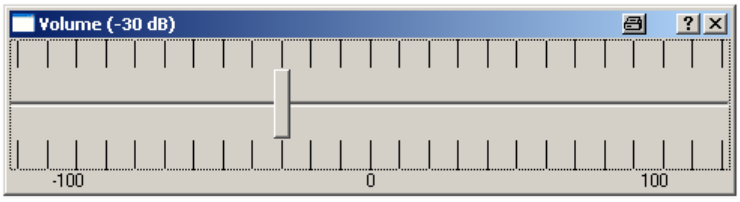
Volume, Volume 1, Volume 2
Used to set the level for monitoring

Depending on the "Signal Source" Track / Split setting, the parameter field for both monitor outputs is provided together for Monitor 1 and Monitor 2 for "Track" and separately for "Split" so that different levels can be set for Monitor 1 and Monitor 2.

Range from -120 dB (lowest level) up to 120 dB (highest level).

Note: Volume settings above 0 dB may cause the enlarged digital signal to be overdriven and thus the monitoring signal to be distorted.

If "Signal Source" is set to "Track" and if CTRL+F9 is pressed on the external keypad, the following panel appears on the screen



which can be used to change the output voltage simultaneously for both monitor outputs.

If a mouse is connected to the R&S UPP, the horizontal slider can be operated directly. The output voltage can also be adjusted using TAB / SHIFT TAB in 1-dB steps and with PAGE UP / DOWN in 10-dB steps on the external keypad.

The entry window is closed again by clicking the cross in the top right-hand corner, using ENTER or pressing CTRL+F9 again.

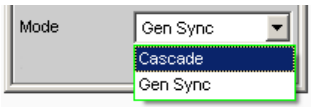
Remote command:
AUXiliaries:SPEaker:VOLume<n3> on page 742

Enable
For enabling or disabling the trigger output.

If the trigger output is deactivated, there is a low level at the TRIGGER OUT BNC jack on the rear of the instrument.

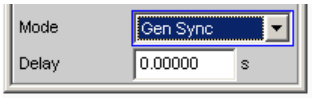
Remote command:
AUXiliaries:TRIGger:OUTPut:ENABle on page 742

Mode
Operating mode of the TRIGGER OUT BNC jack on the rear of the instrument.



"Cascade" Reserved for later applications.

"Gen Sync" After starting the generator, a positive pulse with a length of 1 ms is output at the TRIGGER OUT BNC jack on the rear of the instrument; the pulse can be used to trigger external instruments or circuits.

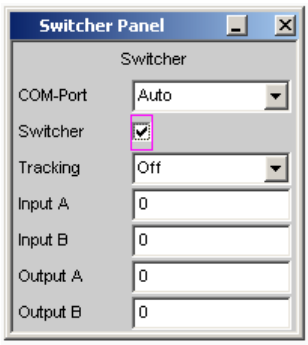


The delay determines the time from the start of the generator to the output of the trigger pulse.

Remote command:
AUXiliaries:TRIGger:OUTPut:MODE on page 742
AUXiliaries:TRIGger:OUTPut:DELay on page 742

5.41 Switcher Panel

This section describes how to connect and operate the R&S UPZ switcher on the R&S UPP.



5.41.1 Connecting the Switcher to the R&S UPP

R&S UPP can be connected to R&S UPZ Audio Switchers.

Older R&S UPZ models .02/.03 that do not have a USB interface can be connected, using a conventional **USB to serial adapter**, to the R&S UPP, see the "COM-Port" parameter field.

The new R&S UPZ models .12 and .13 have a USB interface and can be connected to the R&S UPP directly using a USB cable. A driver has to be installed before initial startup! The description for this can be found in the operating manual for the R&S UPZ Audio Switcher, Chapter "Startup", "Connecting Control Lines".

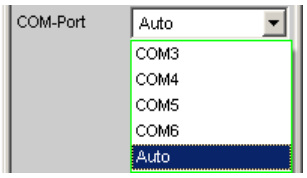
The R&S UPZ may be used as an input switcher or an output switcher. An input switcher makes it possible to connect up to eight different DUTs to the two analyzer inputs without having to change connectors each time. An output switcher can supply up to eight DUTs with the generator channels delivered by the R&S UPP.

Up to 16 input and 16 output switchers can be connected to the R&S UPP, making up to 128 channels available.

The two busbar connections A and B on the front panel of the R&S UPZ have to be connected to the R&S UPP. In the case of an input switcher the XLR connectors on the busbar are connected to the analyzer inputs, and in the case of an output switcher the XLR connectors on the busbar are connected to the generator outputs.

The R&S UPZ is controlled via the COM interface of the R&S UPP.

COM Port



The R&S UPZ is fitted with an RS232 interface for connection to a control unit. The R&S UPP does not supply this interface, but provides several USB interfaces. The R&S UPZ switcher on the R&S UPP is therefore connected by a **USB to serial adapter** that can be purchased from a retailer at low cost. The driver software for this adapter must be installed on the R&S UPP.

Note: Selecting the COM port sets the RS232 parameter in such a way as to guarantee the connection to the switcher without any further settings. The easy to handle setting "Auto" is recommended!

After installing the **USB to serial adapter** or changing the COM port, the R&S UPP must be restarted.

"COM3 ... COM6" Direct specification of the COM port occupied by a switcher. The call setup to the switcher is done quickly. Note that the COM port number may change if the switcher is connected to another USB port. Therefore, the direct specification of the COM port is recommended only if it is ensured that the wiring of the switcher does not change.
If the COM port the switcher uses to communicate is to be entered here, the port has to be determined after the installation of the **USB to serial adapter** by using the Windows XP Device Manager: Open Start, Settings, Control Panel, System, Hardware, Device Manager, Ports (COM&LPT) and right-click on the USB to serial adapter entered there to open its Properties. With Port setting, Advanced, you can determine the interface to report it with this parameter field to the control software of the R&S UPP or the COM port listed in the Device Manager is adjusted to the COM port selected in the R&S UPP.

"Auto" All COM ports from 3 to 256 are searched for a connected switcher and, if necessary, the connection is established. This search process takes longer than the direct input of the COM port, but it generally leads to immediate success without having to observe the COM port number.

Remote command:
`SWITcher:COMPort` on page 743

5.41.2 Default Setting

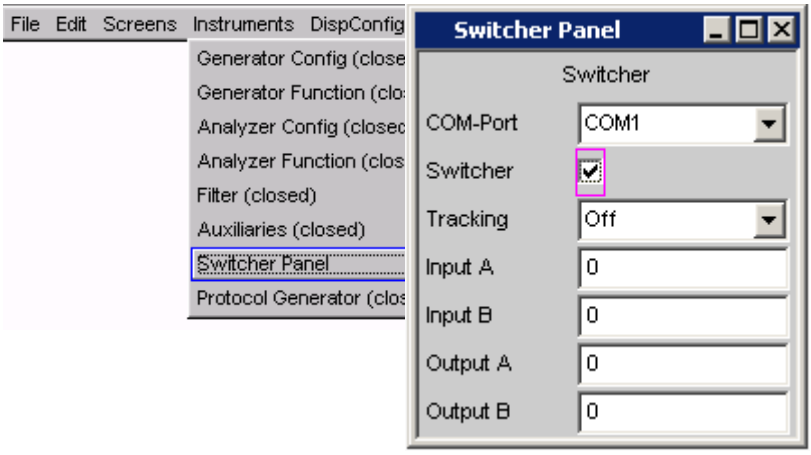
If the switcher is operated for the first time after loading the R&S UPP default setup (preset), the channels are set to a defined default state: All channels of the two switcher types are set to "0", i.e. open. If additionally tracking is activated for the first time, tracking "B vs A " is set to "-1" and tracking "Out vs Inp " is set to "0".

This ensures that when the user interface is opened all channels are open and thus prohibited states in the test setup are avoided.

If you wish to obtain the same setting as in the default state manually, simply enter "All " as the Tracking setting and set any channel to "0". All the others are then also adapted.

5.41.3 Operation

Open the panel for operating the switcher as follows: "Menu – Instruments – Switcher Panel "



Switcher

The checkbox activates or deactivates the operation of the switcher. This status is not dependent on whether the panel itself is open or not.

Remote command:
SWITcher:STATe on page 744

Tracking

The channels of the connected switchers can be used not only independently of one another ("Tracking" "OFF"), but together as well. This makes it possible to select a channel offset between the two busbars and/or between input and output switchers. When one of the parameter fields Input A/B or Output A/B is then used, the other one(s) is/are automatically adapted by the R&S UPP in accordance with the offset that has been set. Channels < 0 are set to 0, that is, the busbar is switched off.

"Off" Tracking is off and the channels can be connected independently of one another.

"B vs A" The channels are switched to an offset between the busbars A and B. This offset can be set in the parameter field "B vs A ".
Application:
Measurements of multichannel DUTs.

"Out vs Inp" The channels of input and output switchers are switched to an offset that can be set in the parameter field "Out vs Inp ".
Application:
Crosstalk measurements in the adjacent channel.

"All " Combines both tracking options described above.

Remote command:
SWITcher:TRACking on page 744

B vs A

For entering the channel offset between the busbars A and B, in common for input and output switchers.

This parameter field only appears when tracking "B vs A" or "All" is selected.

Remote command:
SWITcher:OFFSet:BVSA on page 743

Out vs Inp
For entering the channel offset between input and output switchers.

This parameter field only appears when tracking "Out vs Inp" or "All" is selected.

Remote command:
SWITcher:OFFSet:OVSI on page 743

Input A
For entering the channel number of the input switcher that is to be connected to busbar A.

It is not possible to set this channel to busbar B. If this is attempted, a correction is made to the next higher or next lower channel number.

Remote command:
SWITcher:INPA on page 743

Input B
For entering the channel number of the input switcher that is to be connected to busbar B.

It is not possible to set this channel to busbar A. If this is attempted, a correction is made to the next higher or next lower channel number.

Remote command:
SWITcher:INPB on page 743

Output A
For entering the channel number of the output switcher that is to be connected to busbar A. This setting changes its significance when -1 is set under "Output B", see under that section.

It is not possible to set this channel to busbar B. If this is attempted, a correction is made to the next higher or next lower channel number.

Remote command:
SWITcher:OUTA on page 743

Output B
Used to connect the channel number of the output switcher that is to be connected to busbar B. Here it is possible to enter "-1" as the channel number. The result is that **all** channels of **all** connected switchers in busbar B are closed, with the exception of the one that is selected in busbar A. This setting is useful for worst-case crosstalk measurements. If no channel is selected in busbar A ("Output A" = 0), all channels in busbar B are closed.

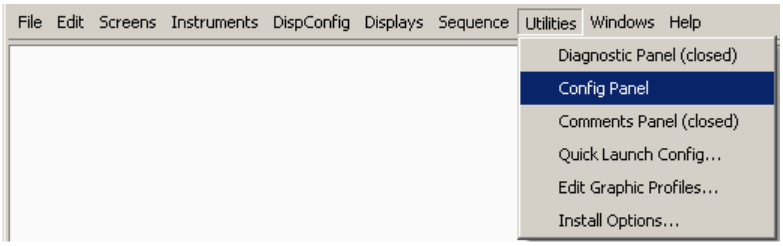
It is not possible to set this channel to busbar A. If this is attempted, a correction is made to the next higher or next lower channel number.

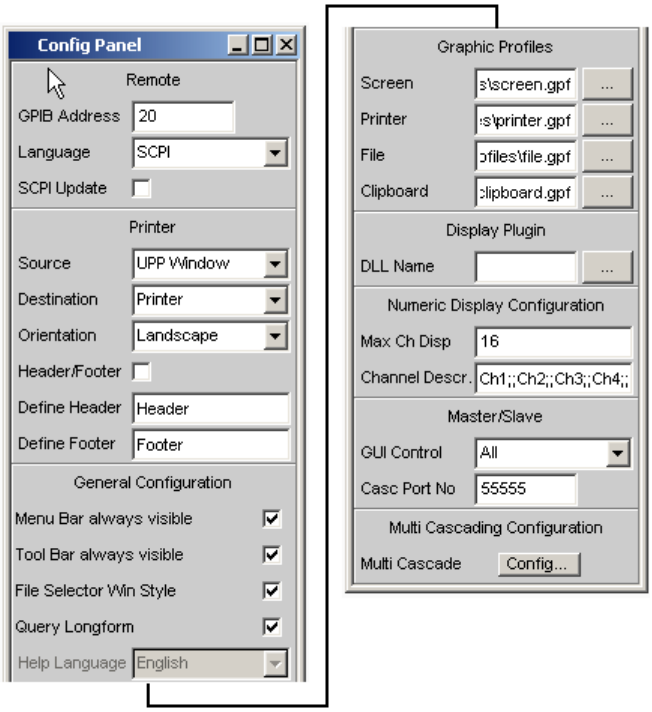
Remote command:
SWITcher:OUTB on page 744

5.42 Config panel

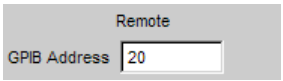
This section describes the Config panel of the R&S UPP where settings are made that affect the behavior of the instrument (across panels in some cases).

The panel is called up using the menu line:





GPIB Address
Entering a IEC/IEEE bus address



The IEC/IEEE bus address of the instrument is factory-set to 20 and can be modified here. Addresses from 0 to 30 are permissible. For more information, see chapter 6.3.1, "Remote Control by IEC/IEEE Bus ", on page 611.

Remote command:
`SYSTem:COMMunicate:GPIB:ADDRess` on page 808

Casc Port No
Port number for establishing a cascade connection.

The port number is part of an IP address. If the port number from the master and slave do not match, a connection cannot be established, which is evident by the rapid flashing of the slave's CASCADE LED. The message "Slave couldn't receive connection …" appears on the slave's user info line.

The connection log on the master can be viewed to check the process of establishing the connection. This requires that a monitor, mouse and keyboard be connected to the master or slave instrument. Double-clicking in the user info line displays a box with the history of the self-explanatory error messages.

If the port number is already being used by another tool when the firmware starts, the error message **"Could not open cascading server port. Please change the cascading port number."** appears. If a connection has already been established between the master and slave but the port number is also being used by another tool the error message **"Cascading data handshake failed. Please consider changing the cascading port number."** appears. The remedy in both cases is to modify the port numbers on all instruments in the cascade so that they are standardized or uniform. Any port number from the specified value range can be selected as the new port number. The problem should be corrected after all instruments have been switched off and back on.

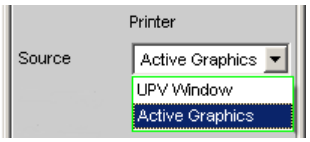
Remote command:
`SYSTem:CASCade:PORTno` on page 807

SCPI update
Determines whether the panels are to be updated during remote control mode (checked) or not.

For reasons of speed this update should be switched **off**. The panels then show the device status **before** changing to remote control mode. While generating a remote control program it can be useful to enable updating so that you can see the effect of the remote control commands.

Remote command:
`SYSTem:DISPlay:SCPiupdate` on page 808

Source
Selection of the screen content to be output.

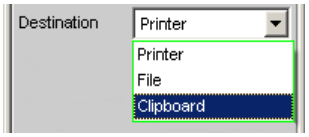


"UPx Window" This setting outputs the entire screen of the R&S UPP as a bitmap. This is the default after firmware installation.

"Act. Graphics" This setting outputs the momentarily active graphical window as a vector graphic. This applies to the FFT Graph, Waveform, Bargraph and Sweep Graph graphics. The type of graphic depends on the target device.

Remote command:
HCOPy:SOURce on page 792

Destination
Selection of the destination for the screen content to be output.



"Printer" The screen content selected under "Source" is output direct to the printer set as the default printer under Windows XP. Graphs are output in vector format, screenshots as bitmaps.

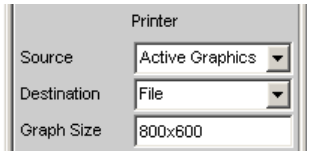
"File" The screen content selected under "Source" is output to a file specified under "File Name". The selected file extension determines the format of the graph, either vector or bitmap format. Screenshots are always output as bitmaps.

"Clipboard" The screen content selected under "Source" is output direct to the Windows clipboard and can be used direct in other applications. The output is always as bitmap.

Note: If the instrument is being remotely controlled from the Windows XP Remote Desktop, the "Clipboard" setting allows you to transport graphics direct between the instrument and the host computer.

Remote command:
HCOPy:DESTination on page 791

Graph Size
Resolution for vector graphs



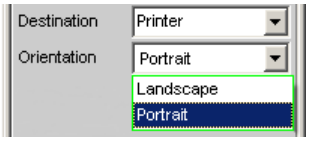
A change to the resolution is only provided for the "Source " = Act. Graphic and "Destination " = File | Clipboard settings. These settings produce a vector graph whose resolution can be specified.

Bitmaps whose resolution cannot be changed without a major loss of quality are used for the settings "Source" = UPP Window or "Destination" = Printer, which is why an option to define the resolution is not available.

The setting made here remains unaffected by preset or by loading a setup; it is therefore bound to the device.

Remote command:
HCOPy:GSIZe on page 792

Orientation
Selection of the orientation wished on the Windows printer (only if "Destination" is configured as "Printer").



"Portrait" Output on the printer is in portrait format.

"Landscape" Output on the printer is in landscape format.

Remote command:
`HCOPy:PRINter:ORIentation` on page 792

Header Footer
Selection of the required header and footer in the output.

"activated" The header and footer are visible.

"deactivated" The header and footer are not visible.

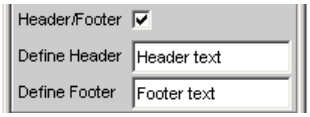
Remote command:
`HCOPy:PRINter:ADDition` on page 792

Define Header
Desired text for the header

Not available if Header/Footer has been activated. This text forms the title in the middle of the header line.

Remote command:
`HCOPy:PRINter:HEADer` on page 792

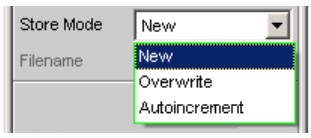
Define Footer
Desired text for the footer



Not available if Header/Footer has been activated. This text forms the legend in the middle of the footer line.

Remote command:
`HCOPy:PRINter:FOOTer` on page 793

Store Mode
Selection of the mode for output to a file



Only available if "Destination" is set to File.

"New" To H COPY to open the file selection box and enter the name of the destination file. See also the section chapter 5.55.1, "Saving Setups", on page 606.

"Overwrite" Output is always to the file of "File Name", which is overwritten without asking you each time.

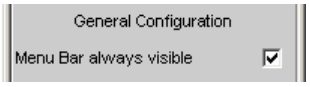
"Autoincrement" Output is to a file whose name is composed of two parts: The beginning of the file name is that name entered as "File Name", followed by a consecutive number that is incremented by 1 every time you press H COPY.

Remote command:
`HCOPy:FILE:MODE` on page 792

File Name
Selection of the desired file name for the output to a file. Only available if "Destination" is set to File and "Store Mode" is not set to New. The file selection box opens for you to change the file name (see section chapter 5.54, "Loading and Saving", on page 605). Enter the file name without an extension; the "File Type" setting in the file selection box defines the file type.

Remote command:
`HCOPy:FILE` on page 791

Menu bar always visible
Permanently displays the menu bar.



The audio analyzer allows you to have the menu bar displayed at the top edge of the screen all the time. This feature is primarily for operation with the mouse.

"activated" The menu bar is permanently displayed on the top edge of the screen

"deactivated" The menu bar appears at the top edge of the screen as soon as you move the mouse pointer to the left-hand edge of the screen. The bar disappears again after a function has been selected.

Remote command:
-

Toolbar always visible
Permanently displays the toolbar.

The R&S UPP allows you to have the toolbar displayed at the right-hand edge of the screen all the time. This feature is primarily for operation with the mouse.

"activated" The toolbar is permanently displayed on the right-hand edge of the screen

"deactivated" The toolbar appears on the right-hand edge of the screen as soon as the mouse is moves there. It disappears again as soon as the mouse moves away from the right-hand edge of the screen.

Remote command:
-

File Selector Win Style
The style of the "File Select" window.

"activated" The "File Select" window from Windows is used for selecting files. This makes for very convenient operation when using a mouse.

"deactivated" For selecting files, the R&S UPP uses its integrated "File Select" window that can be operated solely by using an external keyboard.

Remote command:
`SYSTem:WINStyle` on page 811

SCPI Logging/Query Longform
Query response in short or long form.

"activated" The response to a SCPI query is in long form, e.g. query: TRIGger:SOURce? -> Response: **CH1Freq**.

"deactivated" The response to a SCPI query is in short form, e.g. query: TRIGger:SOURce? -> Response: **CH1F**.

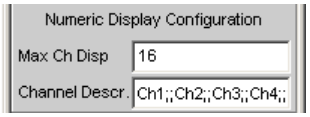
Remote command:
`SYSTem:QLONg` on page 809

Max Ch Disp
Number of simultaneously displayed channels in the numeric display for multi-channel instruments

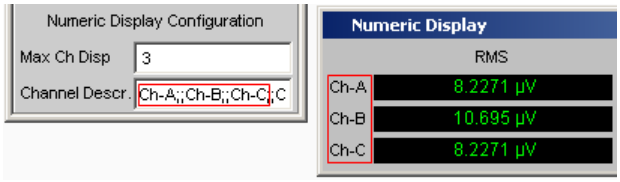
The remaining channels can be reached via the scrollbar.

Remote command:
`SYSTem:MAXChdisp` on page 808

Channel Descr.
Labeling of the display fields in the numeric display.

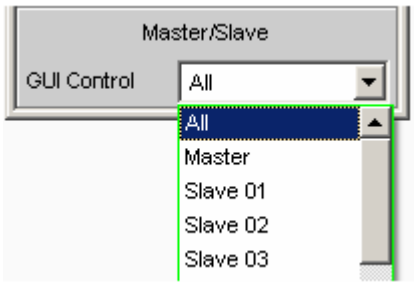


The labeling of the display rows in the Numeric Display is generally Ch1, Ch2, Ch3, etc., but it can be changed with the "Channel Descr." parameter field. The respective string is called: "**Ch-A;;Ch-B;;Ch-C;;Ch-D**;;Ch5;;Ch6;;Ch7;;Ch8;;Ch9;;Ch10;;Ch11;;Ch12;;Ch13;;Ch14;;Ch15;;Ch16".



Remote command:
`SYSTem:CHNString` on page 808

GUI Control
"GUI Control" is provided only for the **master instrument in a cascade** and determines to which instruments the settings made on the master are applied.



For more information, see chapter 8.6.1, "Operating Method", on page 821.

"All " All of the master's settings are transmitted to all slaves.

"Master" All of the master's settings only take effect locally on the master.

"Slave xx" All of the master's settings are transmitted to a specific slave.

Remote command:
-

5.43 Curve, Spectrum and Bar Graph Display

The most informative method of displaying measurement results is usually a two-dimensional graphic. Measured values as a function of frequency, measurements over a time axis and so on are just a few examples of the many possible applications. The R&S UPP Audio Analyzer makes a distinction between the following graphical windows: Sweep Graph, FFT Graph, Waveform and Bar Graph. These windows are set up and modified using the associated configuration panel and displayed as traces or bar graphs.

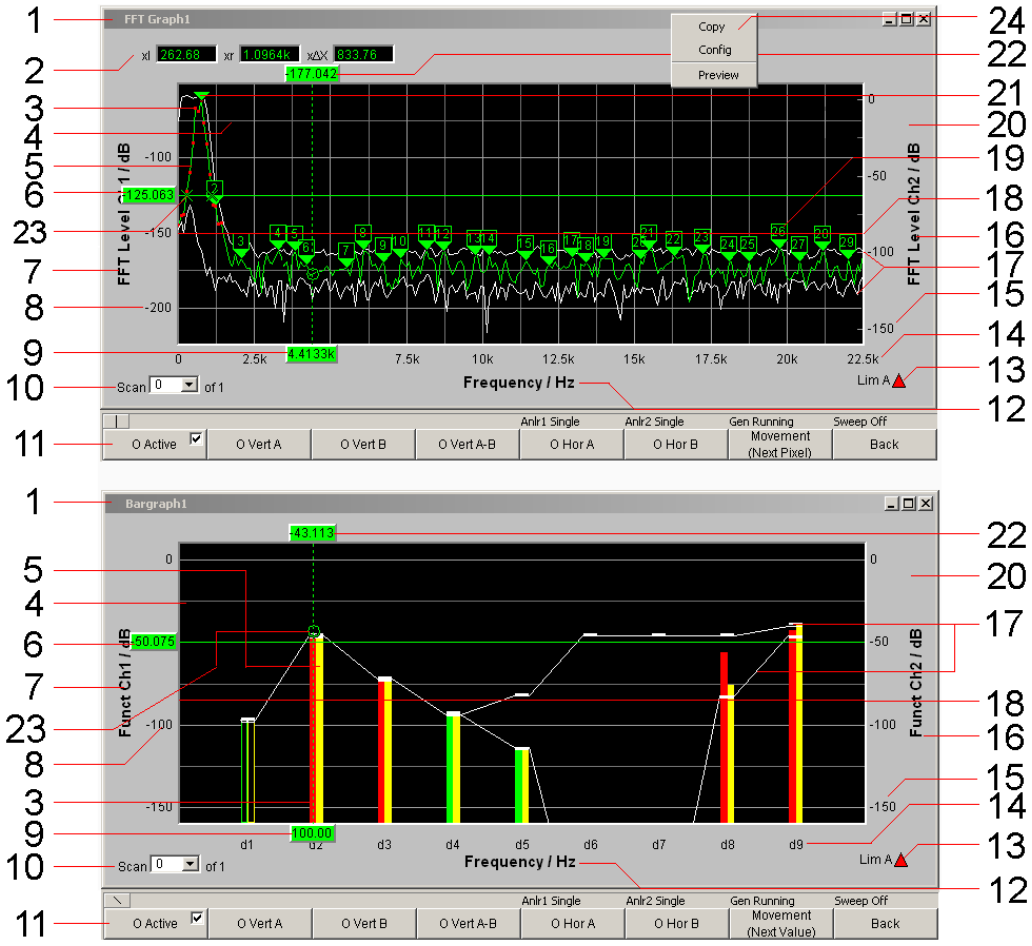
5.43.1 Graphical Display, Explanation of the Elements

Whether a graphical display is shown as a trace or a bar graph depends on the selected display configuration panel.

- The sweep graphs, FFT graphs, and waveform graphical windows are displayed as traces, whereas
- the bar graphs display the measurement results of the analyzer measurement functions THD, THD+N & SINAD, Mod Dist and DFD as bar graphs.

For information on how to set up the various display configurations, see chapter 5.43.2, "Calling Up", on page 483.

The individual elements in the trace and bar graph displays are virtually identical but for one or two exceptions. Only a bar graph which requires a symbolic x-axis (that is, the bar graph for the analyzer measurement functions THD, THD+N & SINAD, Mod Dist, and DFD), does not offer certain elements, such as markers or grid lines for the x-axis.



1: Name of the graphical window
To be set via the menu bar "Displays" or "Disp Config" and the "Display Show" button in the corresponding panel

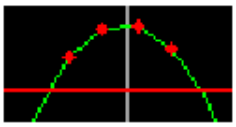
2: Additional cursor values ΔX, ΔY, ol, or, oΔX xl, xr, xΔX

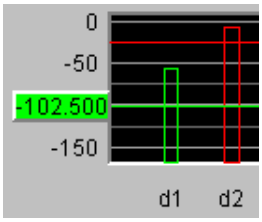
ΔX:	Difference between the X values if the O and X cursors are both activated as the vertical cursor at the same time.
ΔY:	Difference between the Y values if the O and V cursors are both activated as the vertical cursor at the same time.

Only for traces (not for bar graphs):

ol:	The point to the left of the marker at which the O cursor intersects the trace.
or:	The point to the right of the marker at which the O cursor intersects the trace.
oΔX:	Difference between ol and or.
xl	The point to the left of the marker at which the X cursor intersects the trace.
xr	The point to the right of the marker at which the X cursor intersects the trace.
xΔX:	Difference between xl and xr.

3: Limit violations
Limit violations are indicated by red dots on traces or by red bars in bar graphs:





4: Main grid, subgrid
Set in the associated DispConfig panel using the parameter fields

in the sections Trace A, Trace B and x-axis.

In graphic systems Bargraph1 | 2, a grid cannot be set for the x-axis, since this makes no sense for an unscaled x-axis.

5: Trace / bar graph display
Depending on the selected graphic

6, 22: Cursor Y value
Vertical cursors:

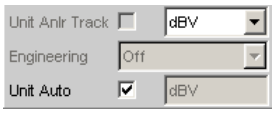
Y value, or if O Vert A-B / X Vert A-B is set, the difference between the Y values for the A and B trace / A and B line.

Horizontal cursors:

Y value on the Y1 and/or Y2 axis.

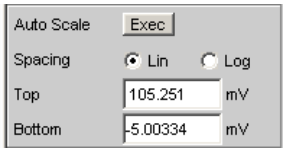
7, 16: Labeling of y-axis
Consists of the label and unit; set with

and



See chapter 5.43.3, "Parameter Fields of the Panel", on page 484.

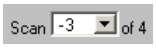
8, 15: Scaling of y-axis
Automatic ("Auto Scale ") or scaling ("Top, Bottom ") of the y-axis to be set manually, to be set using



See chapter 5.43.3, "Parameter Fields of the Panel", on page 484.

9: Cursor X-value
X value for vertical cursors.

10: Scan number



Multiscan mode:

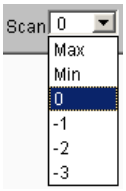
When you use the NEXT SCAN toggle key to scroll through the scans, the current value is entered here. Number 0 means the most recent scan. The lower the negative number, the older the scan.

The **of 4** shown in the example indicates the currently set history and informs the user how many scans are stored in the memory or saved in the file. This value is set in the associated DispConfig panel using

See "History" on page 487.

The entries Min and Max denote the min/max curves, provided these are switched on and are also available in single-scan mode.

Right-clicking the arrow opens a box



in which the desired scan can be selected by clicking the appropriate number. The cursors, markers, limit values and so on are then referenced to this scan.

11: Softkey bar
The softkey menu for the graphical window allows quick configuration of all the important and frequently used settings, especially cursor, marker, and zoom functions, or by clicking with the mouse.

See chapter 5.43.4, "Softkey Menu", on page 536.

12: Label of x-axis
Only for displaying curves, not in graphic system Bargraph1 | 2:

Consists of the label and unit; set with

See chapter 5.43.3, "Parameter Fields of the Panel", on page 484.

13: Limit display

"Limit Upper" △
Limit Upper is activated and there is no limit violation.

"Limit Lower" ▽
Limit Lower is activated and there is no limit violation.

"Limit Upper past" ⚠
The "Limit Upper" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Lower past" ⚠
The "Limit Lower" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Upper current" ▲
The "Limit Upper" value is currently being violated.

"Limit Lower current" ▼
The "Limit Lower" value is currently being violated.

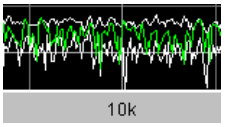
14: Scaling of x-axis
Only for displaying curves, not in graphic system Bargraph1 | 2:

Automatic or manually set scaling of the x-axis; set with

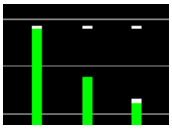
See chapter 5.43.3, "Parameter Fields of the Panel", on page 484.

17: Min/Max curve
The min/max curves are displayed in white.

The min curve represents the lowest value of Y in a measurement sequence and the max curve represents the highest.



In the graphic system Bargraph1 | 2 the minimum and maximum values are shown as small white blocks.



To be set in the upper part of the associated panel via the parameter field.

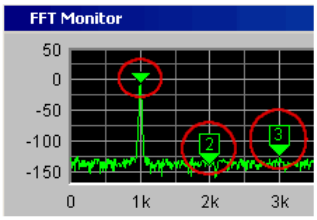
The min/max curves are to be thought of as scans of a multiscan display. If "Show Min Max" is on, there is a single scan from three scans.

18: Limit line
Fixed limit value or fixed limit value curve from a file, for activation in the associated DispConfig panel via the parameter fields

and

in the sections Trace A and Trace B.

19: Harmonic markers
In the following example, starting from the X position of the marker (1 kHz), the harmonics (2 kHz and 3 kHz) are marked.

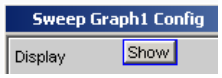


The harmonic markers are activated using the softkeys:

Available in the graphics subsystems

FFT

20: Graphical window
The graphical window to each graphics subsystem is opened from each Display Config Panel using



or directly from the menu bar

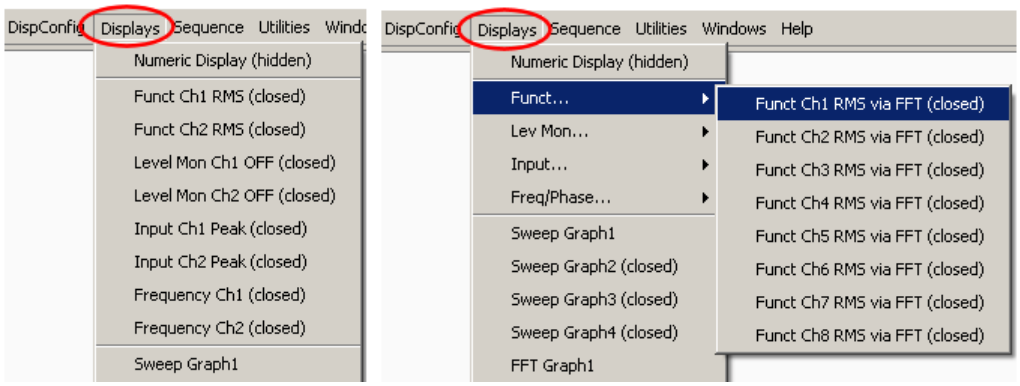
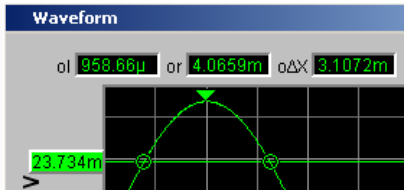


Fig. 5-21: Display menu for two and multichannel instruments

21: Marker
Marking of the value on the x-axis from which the left and right intersections of a horizontal cursor will be displayed with the curve.

Additionally for the graphic systems FFT Graph1 | 2:

Marking of a value on the x-axis from which harmonics are calculated.



The marker is set using the softkeys:

Available in the graphics subsystems

Sweep, FFT, Waveform

23: Cursor intersection points
The **O** or **X** at which the cursor line intersects the trace / lines identify the cursor so that a reference to the labels in the softkey bar, such as **O Vert A** or **X Hor A**, is provided.

24: Copy / Config / Preview
Right-clicking anywhere in the graphical display calls up a context menu, left-clicking on one of the entries executes the corresponding function.

Copy:

Copies the graphic to the clipboard (default 800 x 600 pixel). Resolution and aspect ratio of the graphic can be changed in the Config panel in the Printer area with the "Graph Size" parameter field if the "Destination" parameter field is set to "File" or "Clipboard". With a reduction of the resolution, picture elements such as axis labels can be omitted. Compared to the "Copy" function, the shortcut CTRL+C copies the graphic to the clipboard with the exact resolution and aspect ratio as shown on the monitor.

Config:

Opens the corresponding DispConfig panel.

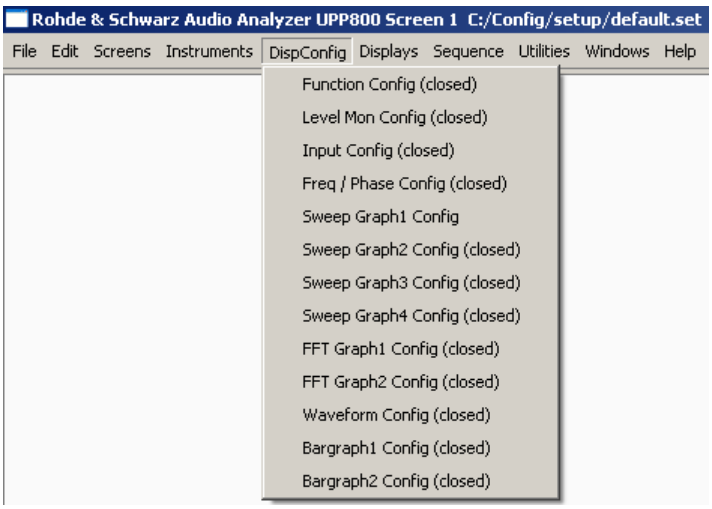
Preview:

Shows a print preview, if the print source "Source" = "Active Graphics" is set in the Config panel in the Printer area. The graphics is always offered with all picture elements in the aspect ratio 4:3.

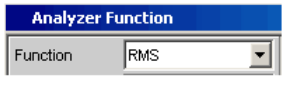
5.43.2 Calling Up

The Display Configuration panel is used to set how measurement results **are graphically** displayed. **What will be measured and how** is set in the "Analyzer Config" and "Analyzer Function" panels or, in the case of sweeps, defined in "Generator Config" and "Generator Function".

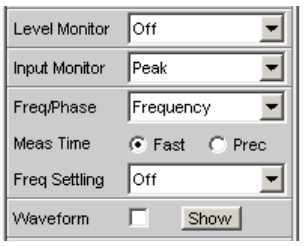
The display configuration panels are opened via the menu bar of the R&S UPP.


Rohde & Schwarz Audio Analyzer UPP800 Screen 1 C:/Config/setup/default.set
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Function Config (closed)
Level Mon Config (closed)
Input Config (closed)
Freq / Phase Config (closed)
Sweep Graph1 Config
Sweep Graph2 Config (closed)
Sweep Graph3 Config (closed)
Sweep Graph4 Config (closed)
FFT Graph1 Config (closed)
FFT Graph2 Config (closed)
Waveform Config (closed)
Bargraph1 Config (closed)
Bargraph2 Config (closed)

A number of different display configuration panels can be selected simultaneously, some of them in two or four windows, e.g. the measurement data sets for the analyzer measurement function RMS



and the measurement data sets for the additional measurement functions Level Monitor, Input Monitor, Freq/Phase Measurement and Waveform



can be displayed at the same time.

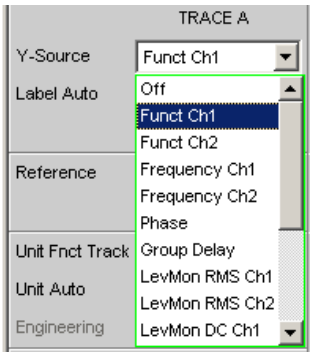
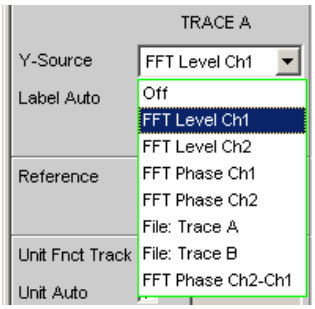
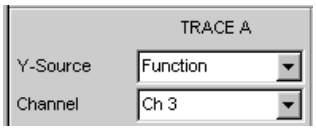
- "Sweep "in 4 windows
  Listed in the menu as "Sweep Graph1 Config" to "Sweep Graph4 Config".
  The panel is used to configure the display of measurement results from a measurement sequence (sweep) as a diagram in the Cartesian coordinate system. Two dependent values can be displayed as TRACE A and Trace B over an independent x-axis.
- "FFT Graph " in two windows
  Listed in the menu as "FFT Graph1 Config " and "FFT Graph2 Config ".
  The panel offers the configuration for displaying a frequency spectrum if the measurement function FFT or the measurement functions RMS, RMS Selective, S/N, THD, THD & SINAD, Mod Dist and DFD "with post-FFT " is selected in the analyzer panel.
- "Waveform" in a window
  Listed in the menu as "Waveform Config".
  The panel is used to configure the display of a waveform (trace of the signal over time) if Waveform is selected as the additional measurement function in the analyzer panel.
- "Bar Graph" in two windows
  Listed in the menu as "Bargraph1 Config " and "Bargraph2 Config ".
  The panel offers the configuration for displaying a bargraph **with symbolic, i.e. non-scaled x-axis** if the measurement function THD, THD+N & SINAD, Mod Dist, or DFD is selected in the analyzer panel.

5.43.3 Parameter Fields of the Panel

The layout of the display configuration panels is almost identical for all of the graphic systems. Depending on the graphic system, parameter fields may be omitted or different parameter lists may appear in the selection fields.

For example, the display configuration panels for FFT and Sweep offer various choices for the sources of the measurement results.

The differences are explained for the individual parameter fields.

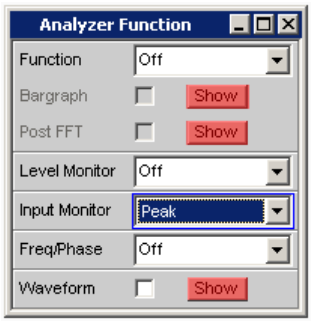
"Sweep " for two-channel instrument	"FFT " for two-channel instrument	"Sweep " for a multichannel instrument
		
The source of the measurement results (FFT Level) and the channel number (Ch1) are combined in the selection list (FFT Level Ch1)		The source of the measurement results and the channel number are separated, since the manifold possible combinations can no longer be displayed in a selection box.

Display

Clicking this button in the Display parameter field activates the graphical display of traces or bar graphs.

To close it, provided it has the focus, click on the CLOSE button or on the X in the title bar (see chapter 5.43, "Curve, Spectrum and Bar Graph Display", on page 476.

A duplicate of this "Show button" can also be found in the Analyzer Function panel so that you can conveniently call up the graphic display for Bar Graph, FFT, or Waveform from there.



Data List

Clicking the button opens a separate window in which the measurement results for Trace A and Trace B and the values to the corresponding x-axis are displayed numerically. To close it, provided it has the focus, click on the CLOSE button or on the X in the title bar (see chapter 5.44, "Result List", on page 545).

Copy to other Windows

The "Copy to other Window" function is available for the respective first window of the Sweep, FFT, and Bar Graph subsystems; in other words, for all subsystems which have more than one window.

As the name says, settings from the first window are copied into all the sub-system's other windows. This happens **once** when the "Exec" button is pressed.

This copying process is performed for almost all commands following a new installation of the R&S UPP.

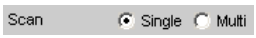
If only specific command areas are to be transferred from the first window to the subsequent windows, limitations can be set in the dialog box which opens when the "Config…" button is pressed.

The checkmarks in the dialog can easily be assigned to the respective panel areas, which are marked by thin lines, by means of their labels.

The selection of command areas made here is unaffected by preset or by loading a setup; it is therefore bound to the device.

Remote command:
`SENSe<n1>:CONFig:COPYother` on page 768

Scan



For the graphics subsystems Sweep Graph 1 to 4: Used to specify whether **one** (Single) or **several** (Multi) measurement sequences are recorded or loaded from a file.

Available in the graphics subsystems

Sweep

If a Z sweep is set in the generator, Scan will automatically be set to Multi, provided that X-Source = Sweep is set in the display panel.

Refer also to chapter 5.48, "Measured value Sequences", on page 577.

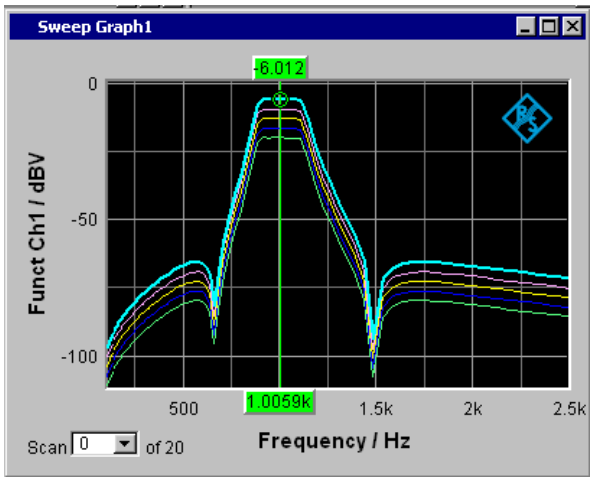
"Single" Only one trace (measurement sequence) or one trace pair (TRACE A and B) is to be recorded or loaded.
The display can be in the form of a trace or a bar graph.

The following parameter fields are hidden:

- History
- New Scan
- Import From

If the "Show Min Max" checkbox is selected, two scans are added to the single measurement sequence, and the toggle key NEXT SCAN can be used to choose between three scans.

"Multi" With this setting, **not just one** measurement sequence or pair of measurement sequences (Trace A and Trace B) is recorded/loaded and displayed but any number of sequences and sequence pairs.



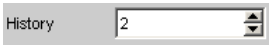
However, only the number selected in the **History** parameter field is stored internally and written to file or read from file; the maximum for this number is 20. The scans that are not stored are only available in the graphic and are lost if the graphical window is moved or resized, if rescaling is performed, if trace files are stored/loaded or if setups are stored/loaded.

The following parameter fields become available:

- History
- New Scan
- Import From

Remote command:
`DISPlay:SWEep<n2>:SMODe` on page 763

History



Only available if "Scan" is set to "Multi" and therefore only for the graphic systems Sweep Graph 1 to 4.

Available in the graphics subsystems

Sweep

History determines how many scans are stored in the memory or saved in the file. It is not possible to select "1" as this number represents single-scan mode.

When the X-source in the display panel is set to Sweep, when a Z-sweep is set in the generator, and when the number of Z-sweep points is larger than the number of scans set in History, the number of sweep points will be transferred from the generator to the "History" field.

Remote command:
`DISPlay:SWEep<n2>:HISTory` on page 763

Show Min Max

If the checkbox is activated, the Min/Max curves will be displayed.

The Min curve represents the lowest value of a measurement sequence and the Max curve the highest value. Recording of Min/Max values will be restarted each time the START key is pressed.

If Min/Max scans have already been recorded and measurement is stopped, the Min/Max curves can be hidden and shown by selecting and unselecting the checkbox.

A MIN/MAX display is also possible for graphic systems which do not have any scans (e.g. FFT Graph), i.e. a MIN scan and a MAX scan are recorded. The "Show Min Max" function is not available in the Waveform graphic system.

Available in the graphics subsystems

Sweep, FFT, Bar Graph

The min/max curves are to be thought of as scans of a multiscan display. If "Show Min Max" is on, there is a single scan from three scans.

If a tracefile containing Min/Max scans is loaded with the following Y-source command files, then this checkmark is set automatically so that these scans are displayed in the graphic: Trace A Trace B

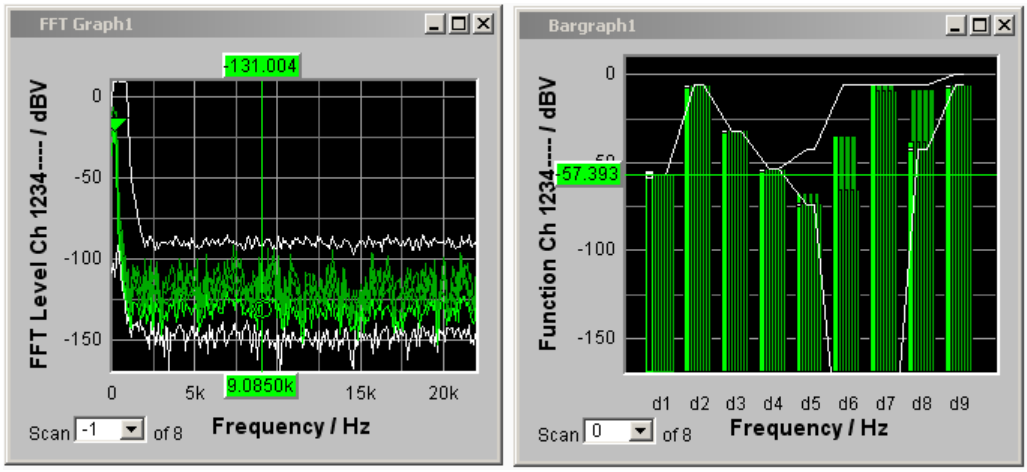
Remote command:

`DISPlay:SWEep<n2>:MINMax` on page 763

Multi Ch Mode

This parameter field is offered for all 8-channel analyzer instruments in the FFT and Bargraph subsystems and allows 8 curves or bars to be displayed in **one** graphical window.

Upon activating this function, the "Channels" parameter field and the option for Trace B disappear in the corresponding Config panel. In the graphical window of the FFT, up to 8 curves are displayed above each other in the same color, in the graphical window of the bar graph display, the bars are shown with a slight offset. The display of the active channel is brightened. The cursor and marker settings refer to it. The active channel can be changed with the "Scan" combo box in the lower left corner of the graphical window. "Show Min/Max" is used to display the min and max values of **all** curves/bars in white. In addition to the measurement result source (Y-source), the left y-axis labeling shows the activated channels, e.g. FFT level **Ch 1234----** / dBV



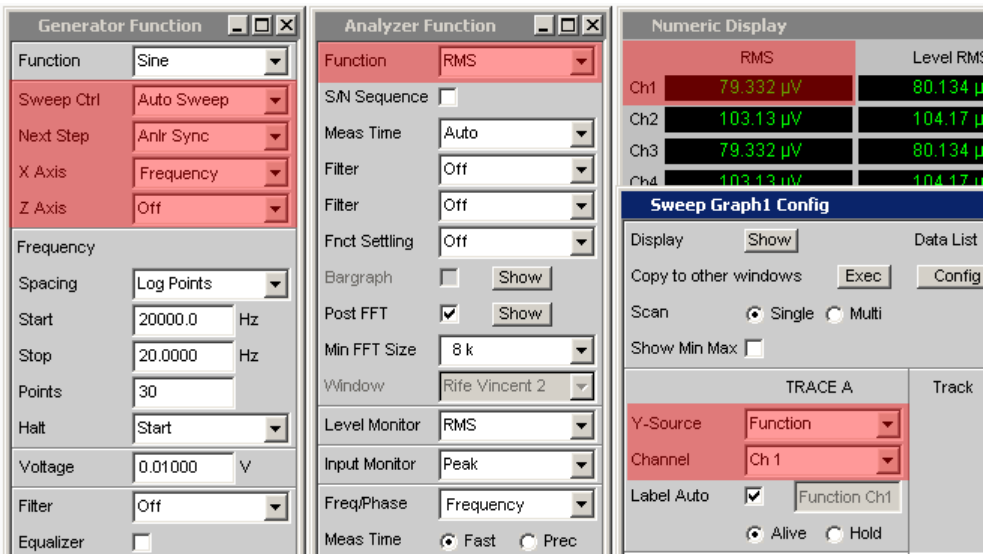
Remote command:
`DISPlay:BARGraph<n2>:MCHMode` on page 763
`DISPlay:FFT<n2>:MCHMode` on page 763

Y-Source
Sweep Graph graphic system

Used to select which sweep measurement results (obtained from one of the sweep functions listed below) are to be collected as TRACE A or as TRACE B and displayed graphically on the left-hand or right-hand y-axis.

Example:

The frequency response of a DUT is determined by means of a generator frequency sweep and the analyzer measurement function "RMS" and displayed in the Sweep Graph graphic system as Trace A.



For more information on Y Source, see chapter 5.48, "Measured value Sequences", on page 577. For displaying the traces, refer also to "X-axis " on page 274.

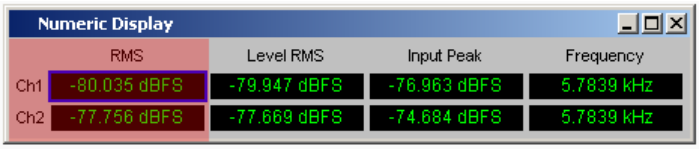
"Off" No trace is displayed or an available trace is deleted.

"Funct Chx, Function"

The **function** measurement result obtained by means of a generator sweep with the set analyzer measurement function for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:



"Frequency Chx, Frequency"

The **Frequency** measurement result for the additional Freq/Phase measurement function.

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

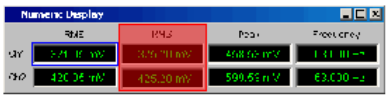
is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:

"LevMon RMS Chx, LevMon RMS"

The **RMS** measurement result of the additional LevelMonitor = RMS measurement function for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:



"LevMon DC Chx, LevMon DC"

The **DC** measurement result of the additional LevelMonitor = DC measurement function for

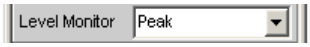
- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:

"LevMon Peak Chx, LevMon Peak"

The **Peak** measurement result of the additional LevelMonitor = Peak measurement function for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

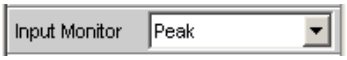


is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:

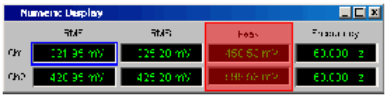
"Inp Peak Chx,Inp Peak"

The **Peak** measurement result of the additional InputMonitor = Peak measurement function for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument



is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:



"Phase"

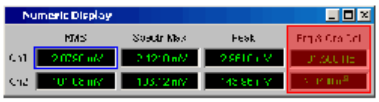
The **Phase** measurement result of the additional Frequ/Phase = Freq & Phase measurement function
If you are using a multichannel instrument, set the channel reference by means of the following "Channel" parameter field.

is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:

"Group Delay"

The **Group Delay** measurement result of the additional measurement function.
Freq/Phase = Freq & Grp Del
If you are using a multichannel instrument, set the channel reference by means of the following "Channel" parameter field.

is displayed as Trace A or Trace B over a basic physical quantity selected under x-axis.
The measurement result is displayed in the numeric display:



"File: Trace A"

Trace A is loaded from a file.
The file name is entered in the subsequent parameter field.

"File: Trace B" Trace B is loaded from a file.
The file name is entered in the subsequent parameter field.

Remote command:
`DISPlay:SWEep<n2>:A:YSOurce` on page 762
`DISPlay:SWEep<n2>:B:YSOurce` on page 762

Y-Source
FFT Graph graphic system

Used to select which measurement results obtained with the **FFT** or **Post FFT** analyzer measurement function are displayed graphically as TRACE A or as TRACE B.

Section of the Analyzer Function panel:

For more information on Y Source (see chapter 5.48, "Measured value Sequences", on page 577).

"Off" No trace is displayed or an available trace is deleted.

"FFT Level Chx, FFT Level" The level characteristic versus the frequency of
- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

of the **FFT** or **Post FFT** analyzer measurement function is displayed as Trace A or Trace B over a frequency x-axis.

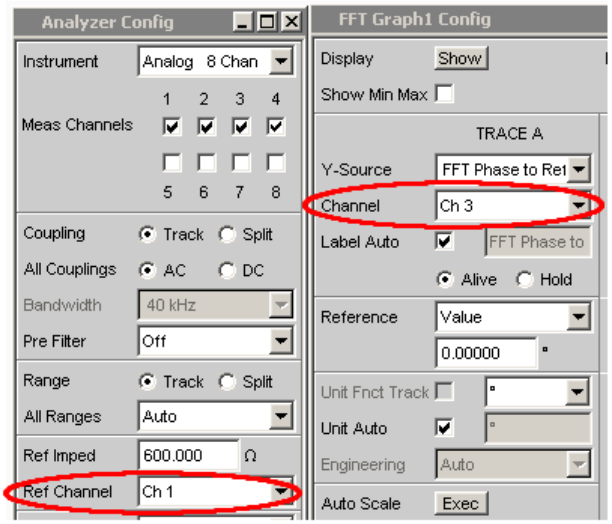
"FFT Phase Chx, FFT Phase" The FFT phase is the phase characteristic versus the frequency of
- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

of the **FFT** or **Post FFT** analyzer measurement function which is displayed as Trace A or Trace B over a frequency x-axis.

"FFT Phase Ch2-Ch1, FFT Phase to Refch"

The phase **difference** between the phase characteristic obtained from the calculation of the complex FFT for

- channel 2 and channel 1
- the channel number specified under the following "Channel" parameter field and the reference channel specified in the "Ref Channel" parameter field in the Analyzer Config panel in the case of a multichannel instrument



of the **FFT** or **Post FFT** analyzer measurement function which is displayed as Trace A or Trace B over a frequency x-axis.
In contrast to a comparably slow frequency sweep with phase measurement, the phase measurement using FF provides very rapid phase measurement results.

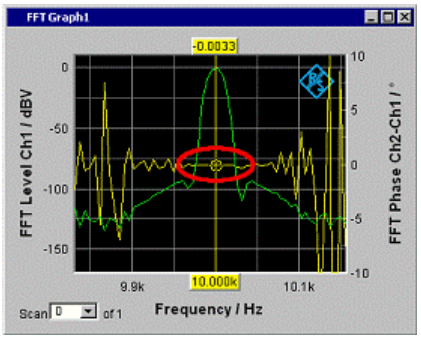


Fig. 5-22: The yellow trace shows the phase characteristic near the 10 kHz frequency line.

"File: Trace A "

Trace A is loaded from a file.
The file name is entered in the subsequent parameter field.

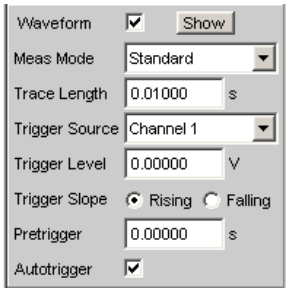
"File: Trace B"
Trace B is loaded from a file.
The file name is entered in the subsequent parameter field.

Remote command:
DISPlay:FFT<n2>:A:YSOurce on page 761
DISPlay:FFT<n2>:B:YSOurce on page 761

Y-Source
Waveform graphic system

Used to select which measurement results obtained with the additional measurement function **Waveform** are displayed graphically as TRACE A or as TRACE B and displayed graphically on the left-hand or right-hand y-axis.

Section of the Analyzer Function panel:



For more information on Y Source (see chapter 5.48, "Measured value Sequences", on page 577).

"Off" No trace is displayed or an available trace is deleted.

"Level Chx, Level"
The level measurement result for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

of the Waveform measurement function is displayed as Trace A or Trace B over a time x-axis.

"File: Trace A "
Trace A is loaded from a file.
The file name is entered in the subsequent parameter field.

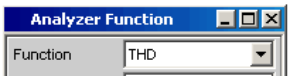
"File: Trace B" Trace B is loaded from a file.
The file name is entered in the subsequent parameter field.

Remote command:
DISPlay:WAVeform<n2>:A:YSOurce on page 761
DISPlay:WAVeform<n2>:B:YSOurce on page 761

Y-Source
Bar Graph graphic system

Used to select whether the measurement result for channel 1 or channel 2 obtained with the analyzer measurement function THD, THD+N & SINAD, Mod Dist, and DFD are collected as TRACE A or as TRACE B and displayed graphically on the left-hand or right-hand y-axis.

Section of the Analyzer Function panel:



For more information on Y Source (see chapter 5.48, "Measured value Sequences", on page 577).

"Off" No trace is displayed or an available trace is deleted.

"Funct Chx, Function"
The function measurement result for

- channel 1 or
- channel 2 or
- the channel number specified under the following "Channel" parameter field in the case of a multichannel instrument

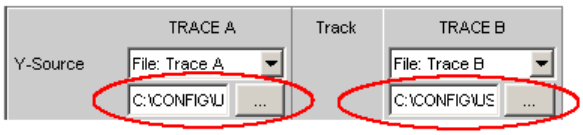
of the analyzer measurement functions THD, THD+N & SINAD, Mod Dist, and DFD is displayed as TRACE A or Trace B versus a true-to-scale x-axis.

"File: Trace A "
Trace A is loaded from a file.
The file name is entered in the subsequent parameter field.

"File: Trace B" Trace B is loaded from a file.
The file name is entered in the subsequent parameter field.

Remote command:
`DISPlay:BARGraph<n2>:A:YSOurce` on page 761
`DISPlay:BARGraph<n2>:B:YSOurce` on page 761

Trace File
All graphic systems



File name of the trace files to be loaded for parameter fields Y-Source = File: Trace A and/or File: Trace B.

If a file cannot be loaded because it does not match the current graphic system or is defective, "not loaded" is displayed.

If a trace file that contains Min/Max scans is loaded, "Show Min Max" is enabled automatically so that these scans are displayed in the graphic.

If files with different x-axes are loaded one after the other, the last file always determines the x-axis. If a sweep with a different x-axis is then loaded, it will determine the x-axis.

For file format, see chapter 5.6.7, "Random", on page 239.

Remote command:
`DISPlay:SWEep<n2>:A:YSOurce:FILE` on page 762
`DISPlay:SWEep<n2>:B:YSOurce:FILE` on page 762

Channel

Channel number for multichannel instrument

For multichannel instruments it is no longer possible to show the source of the measurement results and the channel numbers in a combined display, due to the large number of possible combinations in the selection list for the Y-source. The source of the measurement results (Y-Source) and the channel number (Channel) are therefore offered in separate parameter fields.

For "Y-Source = OFF", "File: Trace A" or "File: Trace B", a channel specification is meaningless and this parameter field is hidden.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

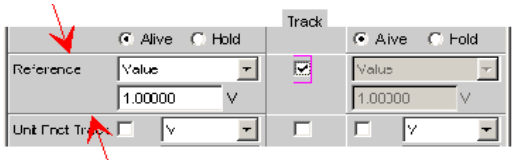
"Ch1 to Ch8" Channel number 1 to 8

Remote command:
`DISPlay:SWEep<n2>:A:CHANnel` on page 754
`DISPlay:SWEep<n2>:B:CHANnel` on page 754

Track

Track

If a checkbox is available in the "Track" column, the settings for the parameters concerned can be transferred from "TRACE A" to "TRACE B". The horizontal partition lines in the panel indicate the parameters for which tracking applies. Tracking capabilities are available for the "Reference ", "Scaling " and "Limit "functions.



Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"activated" The contents of the parameter fields for "TRACE A" are transferred to "TRACE B". The parameter fields for "TRACE B" then appear grayed out and cannot be accessed.
Setting **changes** in "TRACE A" are immediately applied to "TRACE B".

Example:

"deactivated" The parameter fields for "TRACE A " and "TRACE B " can be accessed and changed separately.

Example:

Remote command:
`DISPlay:SWEep<n2>:TRACk:LIMit` on page 764
`DISPlay:SWEep<n2>:TRACk:REFerence` on page 764
`DISPlay:SWEep<n2>:TRACk:SCALing` on page 764

Label Auto
This setting is for whether the label for the left (Trace A) or right (Trace B) y-axis is oriented on the setting in the "Y-Source" parameter field, or is freely configurable.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"activated"

The label (which is selected under TRACE A or Trace B), i.e. the name of the measurement result which is displayed as TRACE A or Trace B, is displayed dimmed (not accessible) in the text field to the right of the checkbox and also on the y-axis in the graphical display.

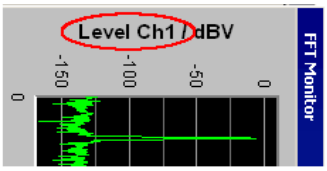


Fig. 5-23: Here rotated by 90°.

"deactivated"

A user-definable label appears on the y-axis of the graphical display.

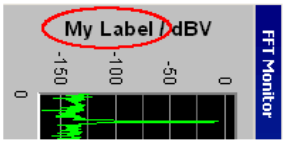


Fig. 5-24: Here rotated by 90°.

Remote command:
`DISPlay:SWEep<n2>:A:LABel:AUTO` on page 754
`DISPlay:SWEep<n2>:A:LABel:USER` on page 754
`DISPlay:SWEep<n2>:B:LABel:AUTO` on page 754
`DISPlay:SWEep<n2>:B:LABel:USER` on page 754

Alive / Hold

Available in all graphic subsystems

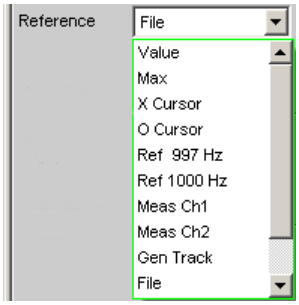
Used to enable or freeze the display of new measured values for Trace A or Trace B (refer also to chapter 5.48, "Measured value Sequences", on page 577).

"Alive" New measured values are displayed.

"Hold" The last trace remains in the display.

Remote command:
`DISPlay:SWEep<n2>:A:UPDate` on page 761
`DISPlay:SWEep<n2>:B:UPDate` on page 761

Reference



Used to select the reference for referenced units (e.g. dBr, V/Vr or ΔHz) for Trace A or Trace B.

Can be a single integer value or a reference trace. The reference can be a sequence of measured values, the current generator frequency or voltage, or it can be loaded from a file (e.g. as a reference trace).

The reference value applies to all integer values in the trace, i.e. measured values, top, bottom and limit values, as well as to all scans of a trace. The same reference value thus applies to all scans.

The Reference parameter field is hidden if you select the function measurement result with Funct Ch1 | Funct Ch2 | Function under Y-source and if an intermodulation measurement is set in the analyzer function panel. Intermodulation measurement results are measurement results that have already been referenced and cannot be referenced again.

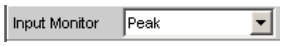
Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"Meas Panel" The reference value from the associated measurement function configuration panel is used.

Example:

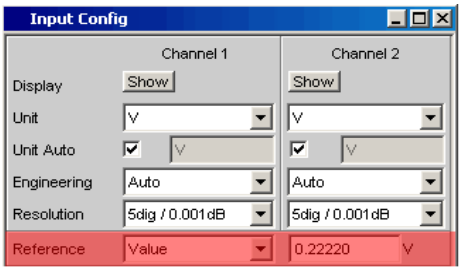
The additional Input Monitor measurement function is activated in the analyzer panel:



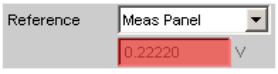
In the Sweep Graph1 graphic system, the result of the Input Peak measurement for channel 1 is selected as the source for Trace A:

The measurement results of the additional Input Monitor Peak measurement function are therefore plotted as Trace A on the Y1-axis.

In the Input Config panel, the reference value for the additional measurement function is set to 0.2222 V.



If Reference is now set to Meas Panel,



the reference value from the Input Config panel is entered here and used if **referenced units** are selected.

In the case of **referenced units**, this transfer of the reference value allows the comparison of measured values in the numerical display field or the combo display with measured values in the graphical display.

Available in the graphics subsystems

Sweep, FFT, Bar Graph

"Value " A numeric value with unit must be entered as the reference value in the parameter field below.

"Max " The maximum Y value of the measurement sequence is actuated once as the reference value. The display then returns to Value and the maximum Y value is displayed as the new reference value in the parameter field below.

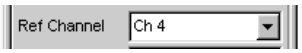
"X-Cursor" The Y value of the * Cursor is actuated once as the reference value. The setting then returns to Value and the reference value is displayed in the subsequent parameter field.

"O Cursor" The Y value of the O Cursor is actuated once as the reference value. The setting then returns to Value and the reference value is displayed in the subsequent parameter field.

"Ref 997 Hz" The Y value at 997 Hz is actuated once as the reference value. The setting then returns to Value and the reference value is displayed in the subsequent parameter field.
If the x-axis is not a frequency axis (e.g. in the case of level sweeps or waveform displays), an error message is displayed and the reference value remains unchanged.

"Ref 1000 Hz" As for Ref 997 but with 1000 Hz

"Meas Ref Ch" This option is only available for multichannel instruments.
Every level measurement result of the channel specified in the Analyzer Config panel under Ref Channel



is saved as a reference value. If a referenced unit is selected in the Unit parameter field, the measurement result is referenced to this variable reference value and displayed.

"Meas Ch1" Moving reference value
Every level measurement result for channel 1 is saved as reference value and used as a referenced display, provided a reference unit was selected. These options are only available for two-channel measurement.

"Meas Ch2" As for Meas Ch1 but with channel 2

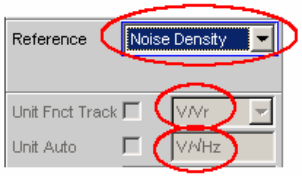
"Gen Track" The reference trace is deleted and the currently applicable generator voltage, and then each newly set generator voltage, is used as the reference value.

"File" The reference trace is loaded from a file. The file name is entered in the subsequent parameter field (see chapter 5.48, "Measured value Sequences", on page 577). If Trace A is to be referenced, then the Trace A from the specified reference file is used; if Trace B is to be referenced, then Trace B is used. An error message occurs if the necessary reference trace is not present in the file.

"File Intern" "File Intern" has to be offered and displayed only if "File:Trace A or File: Trace B is set at "Y-Source" and a trace file containing a reference value scan in addition to the data scan is loaded.

"Noise Density, Noise Density dB"

Noise density measurement.
Offered only in the FFT subsystem.
If you perform an FFT analysis via a noise signal, the level of a bin will change with respect to its width. The width of a bin, which is also called analysis bandwidth, depends on the FFT size. Thus, the level of a bin changes with respect to the FFT size.
To relativize this effect, i.e. to become independent of the actual analysis bandwidth, you calculate the noise density. This is the noise power that would occur in an intended analysis bandwidth of 1 Hz.
The noise density depends on the FFT window. When calculating the noise density, the set window is taken into consideration to eliminate the effect of the window.
Thus, the noise-density measurement is not an independent measurement function but a referenced level display, based on the relative unit V/Vr.



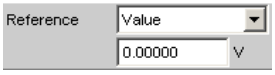
Depending on the selection "Noise Density" or "Noise Density dB", the FFT graphic displays the result in the unit **V/√Hz** or **dBV/√Hz**.

"Hold"

No further changes are made to the reference value or reference trace. If a trace file having a reference value or reference trace is loaded, the reference values from the file have no effect, and the reference value or reference trace last set is used.
If a floating reference value (Meas Ch1, Meas Ch2 or Gen Track) was set before the switchover to "Hold", this reference trace is used.
If "Hold" is selected in the absence of any valid reference trace data, a warning is issued and the last chosen valid reference is set again.

Remote command:
`DISPlay:SWEep<n2>:A:REFerence` on page 759
`DISPlay:SWEep<n2>:B:REFerence` on page 759

Reference Value



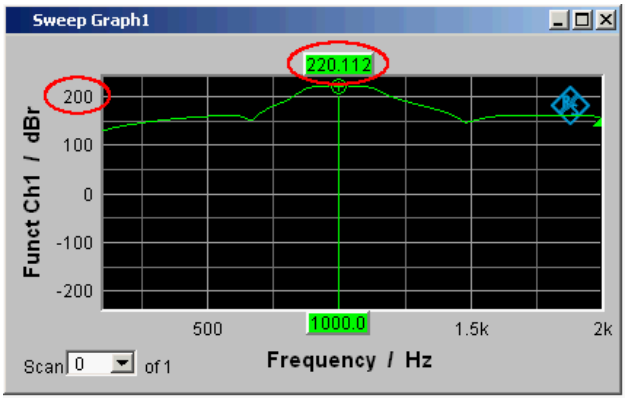
Reference value with unit for the reference parameter Value.

Regardless of the graphic system, the value range allows the value 0 V or negative values to be entered. A reference value of 0 V or a negative reference value makes good sense for display units, such as ΔV or ΔW, but causes problems in the case of logarithmic units such as dBr and in the case of units that have the reference value in the denominator, such as V/Vr.

To get round these problems, a reference value around 0.0 (or more exactly: between -1.0E-12 and 1.0E-12) is always computed using the value 1.0E-12.

Negative reference values < -1.0E-12 are computed using their magnitude, that is, they are made into positive values.

As a result, trace displays in the referenced unit dBr, for instance, at a reference value of 0.0 V have very high values for the upper limit, since the trace data is computed internally using the reference value 1.0E-12.



Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:REFerence:VALue` on page 759

`DISPlay:SWEep<n2>:B:REFerence:VALue` on page 759

Reference File

File name for the reference parameter File.

Available in the graphics subsystems

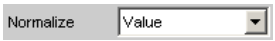
Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:REFerence:FILE` on page 759

`DISPlay:SWEep<n2>:B:REFerence:FILE` on page 759

Normalize



If a referenced unit (e.g. dBr or V/Vr) and a floating reference value, as in Reference = Meas Ch1, Meas Ch2, Gen Track, or a reference trace held in a file, as in "File" or "File Intern", are used, the displayed trace is normalized with the aid of the above by shifting the whole curve, that is, multiplying it by the normalization value.

The normalization value is transferred to all scan data sets; the same normalization value therefore applies to all scans.

The "Normalize" parameter field is hidden if you select the function measurement result with Funct Ch1 | Funct Ch2 | Function under Y-source and if an intermodulation measurement is set in the analyzer function panel. Intermodulation measurement results are measurement results that have already been referenced and cannot be referenced again.

Available in the graphics subsystems

Sweep, FFT, Bar Graph

"OFF" Normalization is deactivated.

"Value " Fixed normalization value which is entered as a multiplication factor or a dB value in the parameter field below.

"O Cursor" The trace is normalized once only at the o cursor to 0 dBr or V/Vr = 1. For this purpose, the referenced trace value is read out and the reciprocal value is entered in the parameter field below. The parameter then changes back to VALUE.

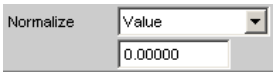
"X-Cursor" As for the o cursor.

Remote command:

`DISPlay:SWEep<n2>:A:NORMalize` on page 758

`DISPlay:SWEep<n2>:B:NORMalize` on page 758

Normalize Value



Used to enter a fixed normalization value as a factor. This value applies to all scans.

Available in the graphics subsystems

Sweep, FFT, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:NORMalize:VALue` on page 758

`DISPlay:SWEep<n2>:B:NORMalize:VALue` on page 758

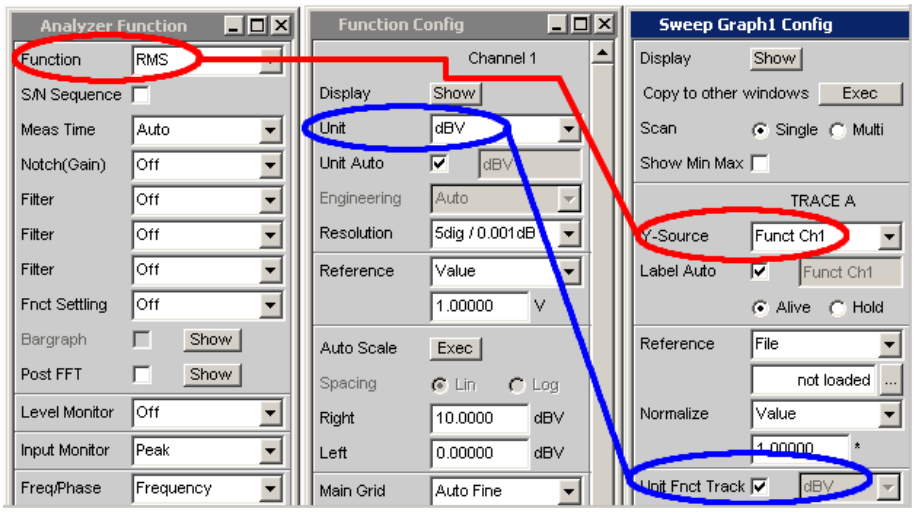
Unit Fnct Track

Used to determine whether the unit is the same as that set in the analyzer or whether it can be user-selected. This parameter field is displayed only for graphics systems that are referenced to the measurement function in the analyzer and whose display unit can be set in the corresponding Config panel.

Example:

In the sweep subsystem, "y-source" is set to "Funct Ch1".

In the Analyzer panel, RMS has been set as measurement function for which dBV has been selected as the unit in the Function Config panel.



The dBV display unit for the RMS measurement function can be transferred to the Display panel which is indicated by the "Unit Fnct Track" checkboxes.

Example:

For the additional measurement function Waveform, there is no individually assigned unit that may be set in a Config panel. Thus, no unit can be transferred from the analyzer for the Waveform graphics subsystem and the checkboxes for "Unit Fnct Track" are not offered here.

Available in the graphics subsystems

Sweep, FFT, Bar Graph

"activated"

The unit selected in the analyzer is used for the measurement data displayed on the y-axis and for the displayed top, bottom and limit values.
It is displayed in gray (cannot be accessed) next to the checkbox and also on the y-axis of the graphical display.
If a logarithmic unit (dBu, dBV, dBr, dBm or dBFS) appears here, the parameter field below (Spacing) cannot be accessed and its parameter is set to Lin (it would be pointless to display measured values with a logarithmic unit on an axis with logarithmic spacing).

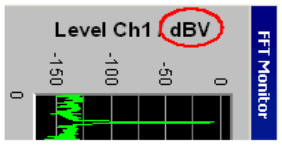


Fig. 5-25: Here rotated by 90°.

The unit which appears here depends on the parameter selected under Trace A or Trace B, e.g. Level Ch1, Phase Ch1 and on the analyzer instrument, e.g. "Analog" or Digital Audio.
In the event of changing between similar units (e.g. dBu. dBV, dBm, or dBr), a new value is computed for the subsequent parameter fields "Top", "Bottom",
"Main Grid Steps",
"Limit Lower Value", "Limit Upper Value",
"Limit Shift Parallel", "Limit Shift Symmetrical";
in the event of changing between different units (e.g. dBV, W), a value entered earlier is retrieved.

"deactivated"

The unit can be user-selected from the list of available parameters.
If a logarithmic unit (dBu, dBV, dBr, dBm or dBFS) is selected here, the parameter field below (Spacing) cannot be accessed and its parameter is set to Lin (it would be pointless to display measured values with a logarithmic unit on an axis with logarithmic spacing).

Remote command:
`DISPlay:SWEep<n2>:A:UNIT:TRACk` on page 761
`DISPlay:SWEep<n2>:B:UNIT:TRACk` on page 761

Unit

This parameter field without the "Unit Fnct Track " is displayed only for the graphic system Waveform, since this additional measurement function is independent of a function setting in the analyzer and even delivers measurement results when the measurement function is turned off. Therefore tracking the unit of the measurement function is meaningless.

The list of units offered at this point is dependent on whether the analog or digital analyzer is selected. The unit can be user-selected from the parameter list.

If a logarithmic unit (dBu, dBV, dBr, dBm, dBFS) is selected, or a linear unit in which negative numbers can occur (e.g. ΔV, ΔW), the following parameter field Spacing is displayed as not user-accessible and its parameter is set to Lin since it makes no sense to display measured values with a logarithmic unit or negative values on a logarithmically scaled axis.

In the event of changing between similar units (e.g. dBu. dBV, dBm, dBr), a new value is computed for the following parameter fields

"Top", "Bottom",

"Main Grid Steps",

"Limit Lower Value", "Limit Upper Value",

"Limit Shift Parallel", "Limit Shift Symmetrical";

in the event of changing between different units (e.g. dBV, W), a value entered earlier is retrieved.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:UNIT` on page 760

`DISPlay:SWEep<n2>:B:UNIT` on page 760

Unit Auto

Used to determine whether the unit label displayed on the y-axis for Trace A or Trace B is the same as the unit set in the "Unit Funct Track" or "Unit" parameter field or whether it can be user-selected.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"activated"

Used to determine whether the unit label displayed on the y-axis for Trace A or Trace B is the same as the unit set in the Unit Funct Track or Unit parameter fields and are therefore generated automatically by the R&S UPP.

"deactivated"

A user-defined unit label can be entered.

Example:

The output level U_{0dBspl} which is output at a sound pressure of 0 dBspl (spl = sound pressure level) is specified for high-quality microphones.

If the measured microphone output level is displayed in the referenced unit dBr and entered for the reference value U_{0dBspl}, the level displayed on the R&S UPP will be in dBr, but corresponds to the sound pressure in dBspl. An axis labeling using the unit dBspl would be desirable in the graphical display. To allow this, the unit label can be changed from dBr to dBspl.

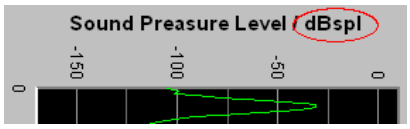


Fig. 5-26: Here rotated by 90°.

Remote command:
`DISPlay:SWEep<n2>:A:UNIT:AUTO` on page 760
`DISPlay:SWEep<n2>:B:UNIT:AUTO` on page 760

Unit User String

User-defined unit designation if Unit Auto is not selected.

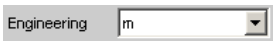
The specified designation appears on the y-axis label instead of the usual units.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:
`DISPlay:SWEep<n2>:A:UNIT:USER` on page 761
`DISPlay:SWEep<n2>:B:UNIT:USER` on page 761

Engineering



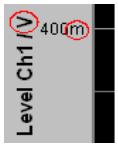
Conversion of the Trace A- or Trace B-related cursor and scaling values in the graphical display by a factor of 1000.

This parameter field cannot be accessed if a dB or % unit is selected in the "Unit Funct Track" or "Unit" parameter field above since these units do not have an engineering function.

Available in the graphics subsystems

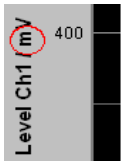
Sweep, FFT, Waveform, Bar Graph

"Auto" Automatic engineering assignment from p to M. The cursor and scaling values are displayed **with** the engineering symbol.
The y-axis is labeled with the unit **without** engineering.

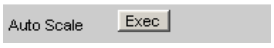


"Off" Engineering is deactivated.
Values are always displayed at 1.0 E^0

"µ, m, k" Engineering fixed to µ, m or k.
The cursor and scaling values are displayed **without** the engineering symbol.
The y-axis is labeled **with** Engineering **and** the unit.



Auto Scale



One-off automatic scaling of the y-axes for Trace A or Trace B.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"Exec" Pressing this button triggers a **one time** scaling process which uses the minimum and maximum values of the existing measurement sequence for Trace A or Trace B.
The end values of the new scaling are approx. 5% less or greater than the exact values. The determined values are entered in the Top and Bottom parameter fields below.
If the "Track" checkbox is enabled for this range, then using "Exec" causes automatic scaling of both y-axes in Trace A, taking the highest maximum value and the lowest minimum value of **both** traces into account. If the Min/Max curves are switched on, these are used for the autoscaling.

Spacing

Linear or logarithmic spacing of the y-axis for Trace A or Trace B.

For logarithmic units (dB units) and linear units in which negative numbers can occur (e.g. ΔV, ΔW), this parameter field is displayed as not user-accessible and is set to "Lin", since it makes no sense / is not possible to display dB values or negative values logarithmically.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"Lin" Linear spacing of the y-axis.
If a logarithmic unit (dB unit) has been selected in the "Unit Fnct Track" line, this line is displayed as not user-accessible and its parameter is set to "Lin", since it would be pointless to display measured values with a logarithmic unit on an axis with logarithmic spacing.

"Log" Logarithmic spacing of the y-axis.
This parameter is available only if a linear unit whose value range cannot contain any negative numbers (e.g. V, W, etc.) has been selected in the "Unit Fnct Track" parameter field.

Example:

Although ΔV is a linear unit, the measurement results can be negative, which means that logarithmic display is not possible.

Remote command:
`DISPlay:SWEep<n2>:A:SPACing` on page 759
`DISPlay:SWEep<n2>:B:SPACing` on page 759

Top

Used to set the top value of the y-axis for Trace A or Trace B

If Auto Scale has been triggered, the value is reset on the basis of the current trace data.

Negative values or the value 0.00000 are not permitted if Spacing = Log.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:
`DISPlay:SWEep<n2>:A:TOP` on page 760
`DISPlay:SWEep<n2>:B:TOP` on page 760

Bottom

Used to set the bottom value of the y-axis for Trace A or Trace B

If Auto Scale has been triggered, the value is reset on the basis of the current trace data.

This value must always be lower than the top value.

Negative values or the value 0.0000 are not permitted if Spacing = Log.

Available in the graphics subsystems

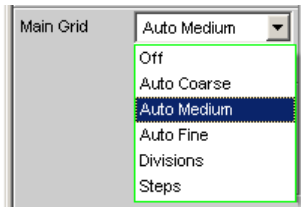
Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:BOTTom` on page 753

`DISPlay:SWEep<n2>:B:BOTTom` on page 753

Main Grid



Division of the graphical display with horizontal main gridlines.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"Off" No main gridlines are used in the graphical display.

"On" With the setting Spacing = Log:
Decadic division of a **logarithmically** divided y-axis with the aid of main gridlines.

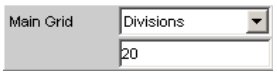
"Auto Coarse, Auto Medium, Auto Fine"
Only selectable with the setting Spacing = Lin:
Coarse, medium or fine division of a y-axis with main gridlines. One or two, 3 or 4, 8 or 9 main gridlines are displayed depending on the scale end values.
Main gridlines may be **hidden** if the graphical window is reduced in size.

"Divisions" Only selectable with the setting Spacing = Lin:
Preset division of a y-axis with main gridlines.
The desired number of divisions is set in the parameter field below.
These main gridlines are **not** hidden if the graphical window is reduced in size!

"Steps" Only selectable with the setting Spacing = Lin:
Preset division of a y-axis in a fixed step size.
The step size is set in the parameter field below.
These main gridlines are **not** hidden if the graphical window is reduced in size!

Division

With the setting Spacing = Lin:



Used to enter the number of main gridline divisions for a y-axis (setting Spacing = Lin) linearly divided by main grid lines.

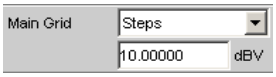
If, for example, 2 is entered, the y-axis is divided into **two sections**, i.e. **one** main gridline is displayed.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Steps

With the setting Spacing = Lin:



Used to enter the main gridline step size for a y-axis.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Sub Grid

Subdivision of the main gridlines in a graphical display using subgridlines.

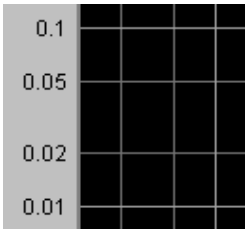
Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

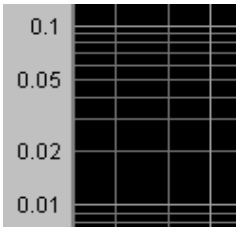
"Off" Subgridlines are deactivated.

"2, 4 , 5 " With the setting Spacing = Lin:
Subdivision of the main gridlines of a y-axis into 2, 4 or 5 sections.
If, for example, 2 is selected, the area between two main gridlines is divided into **2** sections, i.e. **one** subgridline appears between the main gridlines.
These subgridlines are **not** hidden if the graphical window is reduced in size!

"Coarse , Fine " With the setting Spacing = Log:
Coarse or fine subdivision of the main gridlines of a y-axis with subgridlines.

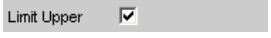


Coarse: Only Subgridlines 2 and 5



Fine: All subgridlines

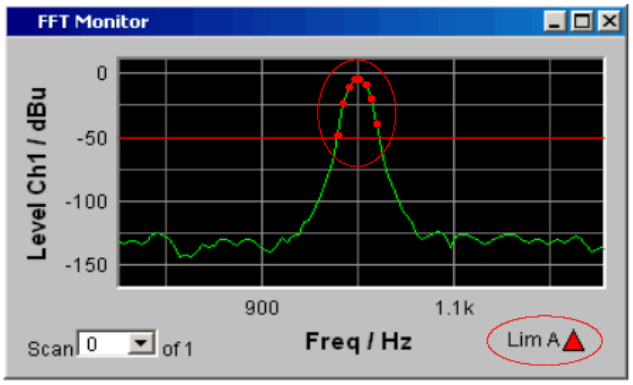
Limit Upper



It is possible to define for a measurement an upper limit / limit curve, such that each measured value is compared with the upper limit or limit curve. The limit / limit curve is plotted in red in the coordinate system of the graphical display.

Limit violations are marked by red dots on a curve or by red bars on a bar graph.

An additional display in the bottom right corner of the graphical display with an arrow pointing **upward** marks the **over**ranging of the upper limit or limit line.



See chapter 5.44.1, "Graphical Display, Explanation of the Elements", on page 545 for the meaning of the limit violation symbols.

Pressing the START key causes the existing limit overranging to be reset and new violations to be recorded.

Available in the graphics subsystems

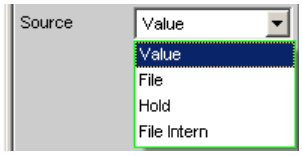
Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:LIMUpper` on page 757

`DISPlay:SWEep<n2>:B:LIMUpper` on page 757

Source



Used to determine how the upper limit is set.

"Value "

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

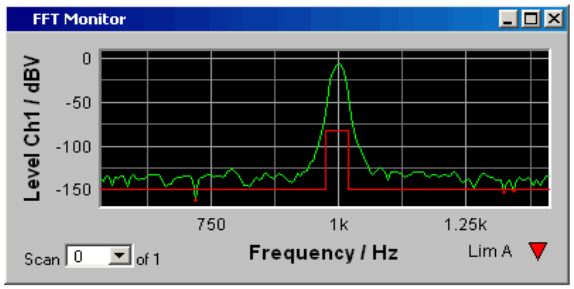
Input of a fixed limit value for the Source = Value setting.

In the parameter field below, an upper limit constant for all X values is entered in the unit which has been selected in the Unit Funct Track parameter field. If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.

All scans of a trace (except the Min/Max scans) are compared to this common limit and the limit violations are marked.

"File"

Available in the graphics subsystems
Sweep, FFT, Bar Graph
Limits are checked by using a limit file.
The name of the limit file is entered in the parameter field below.
This limit file contains reference values for a limit curve in a special format (see chapter 5.51.4, "Limit Files", on page 595).
Each new scan interpolates the entries in the limit file to the X values of the scan.
All scans of a trace (except the Min/Max scans) are compared to this common limit curve and the limit violations are marked.



"File Intern"

Available in the graphics subsystems
Sweep, FFT, Bar Graph
"File Intern" is provided and displayed only if "File: Trace A or File: Trace B is set at "Y-Source" and a trace file is loaded that contains a limit scan in addition to the data scans.
The Limit Upper curve from the trace file is displayed in the graph and all scans are compared to this limit curve (except the Min/Max scans).

"Hold"

Available in the graphics subsystems
Sweep, FFT, Waveform, Bar Graph
The limit value or limit trace is no longer changed. If a trace file is loaded with limit value or limit trace, the limit values from the file are not applied but instead the previously set limit value or limit trace is used. If "Hold" is selected when no valid limit trace data is already available, a warning is issued and the last valid Limit selection is reset.

Remote command:
`DISPlay:SWEep<n2>:A:LIMUpper:SOURce` on page 757
`DISPlay:SWEep<n2>:B:LIMUpper:SOURce` on page 757

Source Value

Upper limit value if "Value" has been selected under "Source".

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

DISPlay:SWEep<n2>:A:LIMUpper:SOURce:VALue on page 758

DISPlay:SWEep<n2>:B:LIMUpper:SOURce:VALue on page 758

Source Filename

File name for an upper limit curve if "File" has been selected under "Source".

Available in the graphics subsystems

Sweep, FFT, Bar Graph

Remote command:

DISPlay:SWEep<n2>:A:LIMUpper:SOURce:FILE on page 758

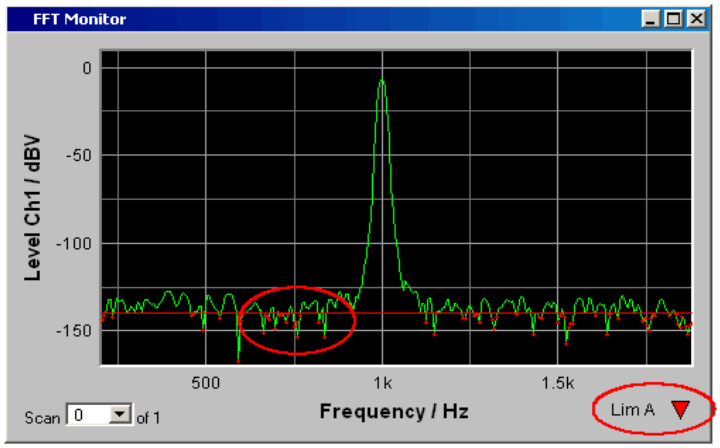
DISPlay:SWEep<n2>:B:LIMUpper:SOURce:FILE on page 758

Limit Lower

A lower limit / limit curve can be defined for the measurement, whereby each measured value is compared with the limit / limit curve. The limit / limit curve is plotted in red in the coordinate system of the graphical display.

Limit violations are marked by red dots on a curve or by red bars on a bar graph.

An additional display in the bottom right corner of the graphical display with an arrow pointing **downward** marks the **under**ranging of the lower limit or limit line.



Pressing the START key causes the existing limit underranging to be reset and new violations to be recorded.

Available in the graphics subsystems

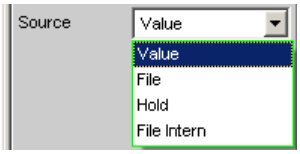
Sweep, FFT, Waveform, Bar Graph

Remote command:

DISPlay:SWEep<n2>:A:LIMLower on page 755

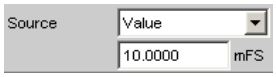
DISPlay:SWEep<n2>:B:LIMLower on page 755

Source



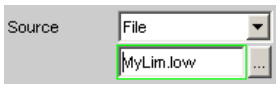
Used to determine how the lower limit is set.

"Value " **Available in the graphics subsystems**
Sweep, FFT, Waveform, Bar Graph

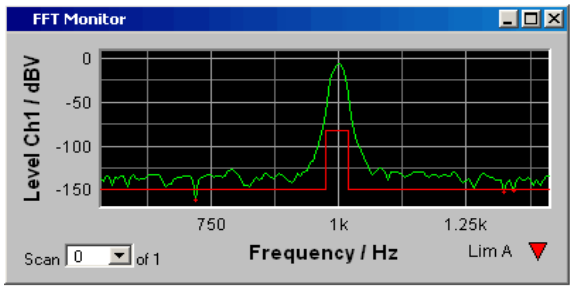


Input of a fixed limit value for the Source = Value setting.
In the parameter field below, a lower limit constant for all X values is entered in the unit which has been selected in the Unit Funct Track parameter field. If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.
All scans of a trace are compared to this common limit and the limit violations are marked.

"File" **Available in the graphics subsystems**
Sweep, FFT, Bar Graph



Available to all graphic systems except Waveform.
Limits are checked by using a limit file.
The name of the limit file is entered in the parameter field below.
This limit file contains reference values for a limit curve in a special format (see chapter 5.51.4, "Limit Files", on page 595).
Each new scan interpolates the entries in the limit file to the X values of the scan.
All scans of a trace are compared to this common limit curve and the limit violations are marked.



"File Intern" **Available in the graphics subsystems**
Sweep, FFT, Bar Graph
"File Intern" has to be offered and displayed only if "File:Trace A or File: Trace B is set at "Y-Source" and a trace file containing limit scans in addition to the data scans is loaded.
The Limit Lower curve from the trace file is displayed in the graph and all scans (except the Min/Max scans) are compared to this limit curve.

"Hold" **Available in the graphics subsystems**
Sweep, FFT, Waveform, Bar Graph
The limit value or limit trace is no longer changed. If a trace file is loaded with limit value or limit trace, the limit values from the file are not applied but instead the previously set limit value or limit trace is used.
If "Hold" is selected when no valid limit trace data is already available, a warning is issued and the last valid Limit selection is reset.

Remote command:
`DISPlay:SWEep<n2>:A:LIMLower:SOURce` on page 755
`DISPlay:SWEep<n2>:B:LIMLower:SOURce` on page 755

Source Value

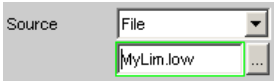
Lower limit value if "Value" has been selected under "Source".

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:
`DISPlay:SWEep<n2>:A:LIMLower:SOURce:VALue` on page 756
`DISPlay:SWEep<n2>:B:LIMLower:SOURce:VALue` on page 756

Source Filename



Filename for a lower limit curve if "File" has been selected under "Source".

Available in the graphics subsystems

Sweep, FFT, Bar Graph

Remote command:
`DISPlay:SWEep<n2>:A:LIMLower:SOURce:FILE` on page 756
`DISPlay:SWEep<n2>:B:LIMLower:SOURce:FILE` on page 756

Limit Shift

This enables limit lines or limit curves to be shifted according to the parameters in the subsequent parameter fields "Parallel" and "Symmetrical".

If the Limit Shift function is enabled without activating limit monitoring, the subsequent parameter fields should be regarded as default settings.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

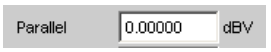
`DISPlay:SWEep<n2>:A:LIMShift` on page 756

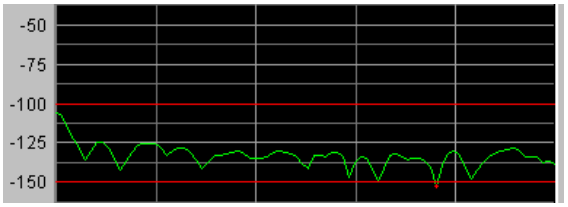
`DISPlay:SWEep<n2>:B:LIMShift` on page 756

Parallel

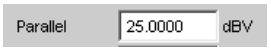
This enables limit lines or limit curves to be parallel shifted.

In this way limit curves derived from a "golden unit", for example, can be adapted very easily to new circumstances





The limit lines, which were determined using -100 dBV and -150 dBV, are to be parallel shifted by a value of 25 dBV to -75 dBV and -125 dBV.



Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:LIMShift:PARallel` on page 757

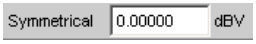
`DISPlay:SWEep<n2>:B:LIMShift:PARallel` on page 757

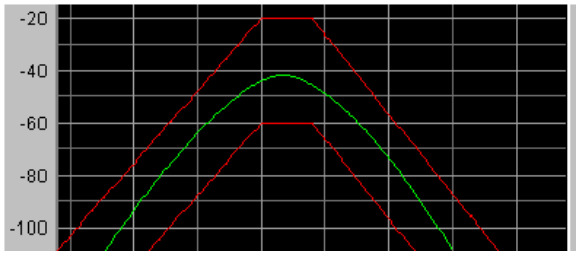
Symmetrical

This enables a tolerance band formed from two limit lines or limit curves to be made broader or narrower

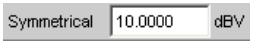
In this way a tolerance band derived from a "golden unit", for example, can be very easily narrowed or broadened.

Although a single limit curve may be symmetrically shifted it is not very meaningful, and would be better done using the "Parallel" parameter field.



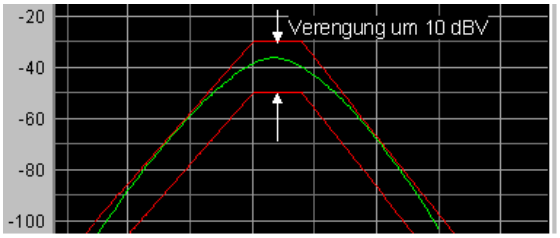


The limit curves that are separated by 40 dBV, such as after loading a file, are **in each case** to be shifted by 10 dBV



and their signs are to be reversed. This produces a symmetrical shift in both curves.

Following the symmetrical shift, the two curves have a separation of only 20 dBV.



Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:A:LIMShift:SYMMetrical` on page 757

`DISPlay:SWEep<n2>:B:LIMShift:SYMMetrical` on page 757

New scan

This parameter field appears only for graphic systems that allow multiscans ("Scan" = "Multi"), and is therefore only available for Sweep Graph 1 to 4 graphic systems.

Available in the graphics subsystems

Sweep

"Replace" means that a selected scan of the current trace will be replaced.

"Append" means that a selected scan will be appended to the current trace.

Here it is irrelevant whether the scan originates from a **measurement** or is imported from a trace file specified in the "Import from" parameter field below.

See chapter 5.48, "Measured value Sequences", on page 577).

"Replace" Replace.
The scan (selected using NEXT SCAN or by means of the scan number in the graphical display) is replaced by the scan from a **measurement** or from the trace file specified in the "Import from" parameter field below.

"Append" The scans from a **measurement** or from the trace file specified in the "Import from" parameter field below are appended to the current trace.

Import from

This parameter field appears only for graphic systems that allow multiscans ("Scan" = "Multi"), and is therefore available to the following graphic system:

Available in the graphics subsystems

Sweep

It is used to enter the name of a trace file whose scans are to replace a current scan or are to be appended to the current trace.

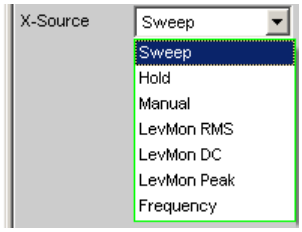
Whether scans are to be replaced or appended is determined in the "New scan " parameter field above:

Replace: "New scan" = "Replace"

Append: "New scan" = "Append"

See chapter 5.48, "Measured value Sequences", on page 577).

X-Source

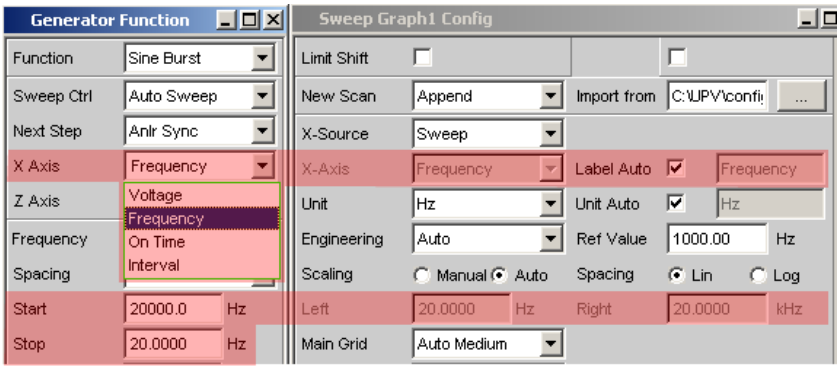


Determines the response of the following x axis parameter field.

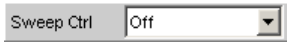
Available in the graphics subsystems

Sweep

"Sweep " The following x-axis parameter field is not available in a sweep that is switched on in the Generator Function panel; as a result, the x-axis in the DispConfig panel sweep is adapted to the x-axis sweep setting in the generator automatically.



The sweep is turned off in the generator



the x-axis parameter field is operable and the user can select the functionality.
When the "x-source " in the display panel is set to "Sweep ", and when a z-sweep is set in the generator, and when the number of z-sweep points in the generator is larger than the number of scans set in History, the number of sweep points from the generator will be entered in the History field.

"Hold" The "x-axis " is displayed as not operable. The x-axis retains the current setting at the time of the switchover to "Hold " and helps prevent the x-axis from being unintentionally destroyed.

"Manual" The following x-axis parameter field is operable and completely independent of a sweep setting in the generator. It is reserved for the special case of graphically displaying self-generated or manipulated trace data records that are transferred from the controller via the IEC bus to the R&S UPP.

Example:

The distortion of an amplifier versus its **output** voltage is to be graphically displayed by means of a generator sweep.

At first glance, this does not seem to be possible, for normally only the generator voltage supplied by the R&S UPP (i.e. the amplifier's **input** voltage) can be swept and projected onto the x-axis.

However, the user would like to display the distortion factor over the **output voltage** on the amplifier in order to be able to assess how the distortion factor changes if the amplifier reaches its limits.

To be able to display the output voltage on the x-axis, this voltage must be measured in addition to the distortion. From these two series of measurements, it is possible to generate a trace data set and save it as a trace file using Visual Basic, for example, in order to graphically display the data set with the setting "Manual " and the following "x-axis " = "Voltage " parameter field.

"LevMon RMS" The measured level monitor RMS value is plotted on the x-axis if the level monitor is on.

"LevMon DC" The measured level monitor DC value is plotted on the x-axis if the level monitor is on.

"LevMon Peak" The measured level monitor peak value is plotted on the x-axis if the level monitor is on.

"Frequency" The measured frequency is plotted on the x-axis.

Remote command:
`DISPlay:SWEep<n2>:X:SOURce` on page 766

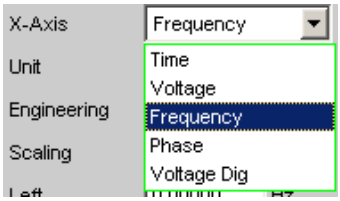
X-axis
The parameter displayed in the selection field depends on the graphic subsystem in which the parameter field is offered.

For the graphic subsystem FFT Graph, the parameter is always "Frequency " and cannot be changed.

For the graphic subsystem Waveform, the parameter is always "Time " and can also not be changed.

The Bar Graph graphics subsystem has an unscaled x-axis that is not displayed, and thus cannot be changed.

In contrast, for the graphic subsystem Sweep Graph1 … 4, the functionality of this parameter field is determined by the "X-Source " parameter field above it, which is only offered in the display configuration panel Sweep Graph1 … 4, and by the sweep setting of the generator.

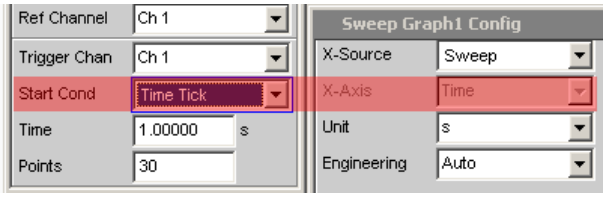


See chapter 5.43.3, "Parameter Fields of the Panel", on page 484.

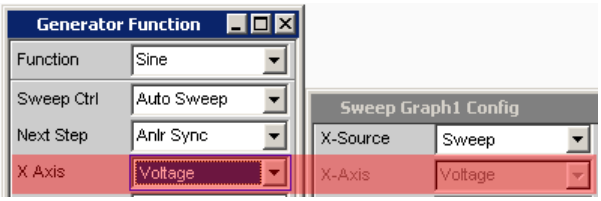
Available in the graphics subsystems

Sweep, FFT, Waveform

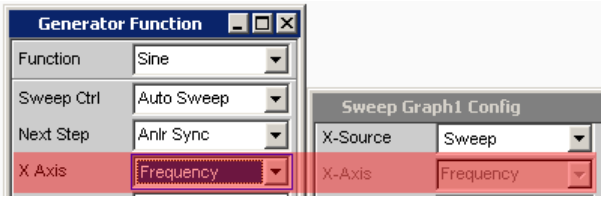
"Time" Depending on the current sweep setting, the x-axis is displayed as the time axis.



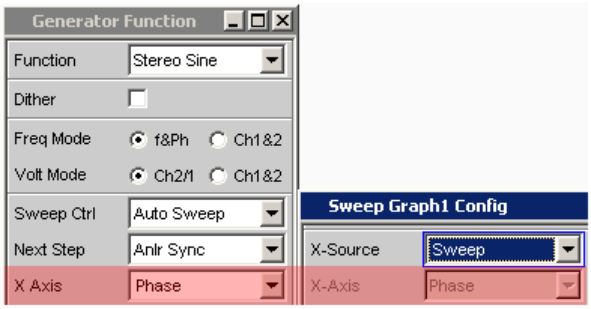
"Voltage" Depending on the current sweep setting, the x-axis is displayed as the analog level axis.



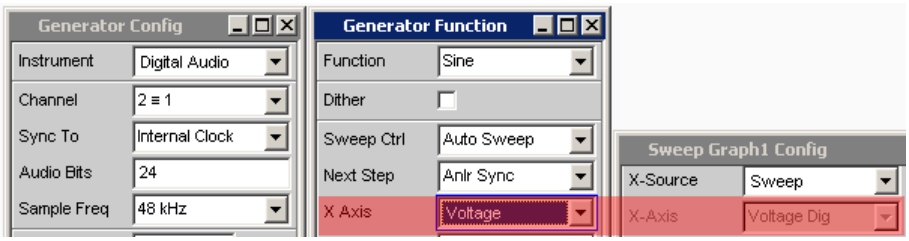
"Frequency" Depending on the current sweep setting, the x-axis is displayed as the frequency axis.



"Phase" Depending on the current sweep setting, the x-axis is displayed as the phase axis. Only available if the generator function Stereo Sine is selected.

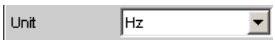


"Voltage Dig" Depending on the current sweep setting in the digital generator instruments, the x-axis is displayed as the digital phase axis.



Remote command:
`DISPlay:SWEep<n2>:X:AXIS` on page 765

Unit



This defines the unit of the values for measurement results, cursor scaling and left/right scaling of the x-axis as well as the units available for the "Ref Value" reference value for referenced units.

The list of units is determined by the setting in the "x-axis" parameter field. If "Frequency" is selected in that field, frequency units are offered here. If "Voltage " is selected in that field, voltage units are offered, and so on.

Recorded measurement sequences can be redisplayed with different units at any time.

Available in the graphics subsystems

Sweep, FFT, Waveform

Remote command:
`DISPlay:SWEep<n2>:X:UNIT` on page 766

Engineering

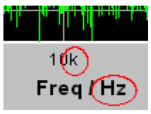
Displays the cursor and scaling values of the x-axis in the graphical display.

This parameter field cannot be accessed if a dB or % unit is selected in the Unit Funct Track parameter field above since these units do not have an engineering function.

Available in the graphics subsystems

Sweep, FFT, Waveform

"Auto" Automatic engineering assignment from p to M. The cursor and scaling values are displayed **with** the engineering symbol.
The x-axis is labeled with the unit **without** engineering.



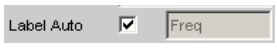
"Off" Engineering is deactivated.
Values are always displayed in 1.0 E^0

"µ, m, k" Engineering fixed to µ, m or k.
The values to be displayed are multiplied by the factor 1.0 E^6, 1.0 E^3 or 1.0 E^{-3}.
The cursor and scaling values are displayed **without** engineering symbol.
The x-axis is labeled **with** Engineering and Unit.

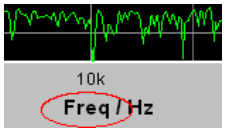
Label Auto
Used to determine whether the x-axis label is the same as that set in the x-axis parameter field or whether the label can be user-selected.

Available in the graphics subsystems

Sweep, FFT, Waveform

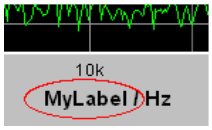
"activated" 

The label in the x-axis parameter field is displayed in gray (cannot be accessed) in the text field to the right of the checkbox and also on the x-axis in the graphical display.



"deactivated"

A user-definable label appears on the x-axis of the graphical display.



Remote command:
`DISPlay:SWEep<n2>:X:LABel:AUTO` on page 765
`DISPlay:SWEep<n2>:X:LABel:USER` on page 765

Unit Auto

Used to determine whether the unit label displayed on the x-axis is the same as the unit set in the Unit parameter field or whether it can be user-selected.

Available in the graphics subsystems

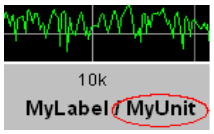
Sweep, FFT, Waveform

"activated"

The unit label displayed on the x-axis is the same as the unit set in the Unit parameter field and is therefore generated automatically by the R&S UPP.

"deactivated"

A user-defined unit label can be entered.



Remote command:
`DISPlay:SWEep<n2>:X:UNIT:AUTO` on page 766

Unit User String

User-defined unit designation if Unit Auto is not selected. This designation appears on the y-axis label instead of the usual unit.

Available in the graphics subsystems

Sweep, FFT, Waveform

Remote command:
`DISPlay:SWEep<n2>:X:UNIT:USER` on page 766

Ref Value

Reference value with unit for referenced units of the x-axis.

Available in the graphics subsystems

Sweep, FFT, Waveform

Remote command:
DISPlay:SWEep<n2>:X:REFerence:VALue on page 765

Scaling

Manual or automatic scaling of the x-axis.

Available in the graphics subsystems

Sweep, FFT, Waveform

"Manual" Manual scaling
The scaling of a graphical display is determined using the "Left " and "Right " parameter fields below.
Each time the "Manual " parameter is set, the graphical display is deleted and then replotted with the scale end values entered under "Left " and "Right ".

"Auto" Automatic scaling
Auto Scale uses suitable default values for **one-off** scaling of the x-axis. These values depend on the measurement task and the subsystem (e.g. the start/stop values of the sweep or FFT are used in the generator and analyzer panel).
The entry fields for the "Left " and "Right " parameter fields below are displayed in gray (cannot be accessed) with the obtained values.

Remote command:
DISPlay:SWEep<n2>:X:SCALing on page 766

Spacing

Linear or logarithmic spacing of the x-axis.

For logarithmic units (dB units) and linear units in which negative numbers can occur (e.g. ΔV, ΔW), this parameter field is displayed as not user-accessible and is set to "Lin", since it makes no sense / is not possible to display dB values or negative values logarithmically.

Available in the graphics subsystems

Sweep, FFT, Waveform

"Lin" Linear spacing of the x-axis.

"Log" Logarithmic spacing of the x-axis.

Remote command:
DISPlay:SWEep<n2>:X:SPACing on page 766

Left

Used to set the left-hand value on the x-axis.

This parameter field can only be accessed if "Scaling" = "Manual" is selected.

Negative values or the value 0.00000 are not permitted if "Spacing" = "Log".

Available in the graphics subsystems

Sweep, FFT, Waveform

Remote command:
`DISPlay:SWEep<n2>:X:LEFT` on page 765

Right

Used to set the right-hand value on the x-axis.

This parameter field can only be accessed if "Scaling" = "Manual" is selected.

This value must always be higher than the Left value.

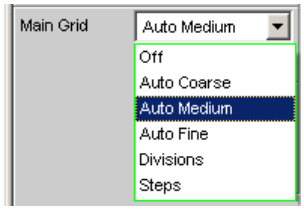
Negative values or the value 0.0000 are not permitted if "Spacing" = "Log".

Available in the graphics subsystems

Sweep, FFT, Waveform

Remote command:
`DISPlay:SWEep<n2>:X:RIGHt` on page 765

Main Grid



Division of the graphical display with vertical main gridlines.

Available in the graphics subsystems

Sweep, FFT, Waveform

"Off" No main gridlines are used in the graphical display.

"On" With "Spacing " = "Log ":
Decadic division of a **logarithmic** divided x-axis with the aid of main gridlines.

"Auto Coarse, Auto Medium, Auto Fine"
With "Spacing " = "Lin ":
Coarse, medium or fine division of an x-axis with main gridlines. One to two, 3 to 4 or 8 to 9 main gridlines are displayed depending on the scale end values.
Main gridlines may be **hidden** if the graphical window is reduced in size.

"Divisions" With "Spacing " = "Lin ":
Preset division of an x-axis with main gridlines.
The desired number of divisions is set in the parameter field below.
These main gridlines are **not** hidden if the graphical window is reduced in size!

"Steps" With "Spacing " = "Lin ":
Preset division of an x-axis in a fixed step size.
The step size is set in the parameter field below.
These main gridlines are **not** hidden if the graphical window is reduced in size!

Division
With the setting Spacing = Lin:

Used to enter the number of main gridline divisions for an x-axis.

If, for example, 2 is entered, the y-axis is divided into **two sections**, i.e. **one** main gridline is displayed.

Available in the graphics subsystems

Sweep, FFT, Waveform

Step
With the setting Spacing = Lin.

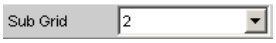
Used to enter the main gridline step size for an x-axis.

The unit of the value is linked to the unit selected in the Unit Funct Track parameter field.

Available in the graphics subsystems

Sweep, FFT, Waveform

Sub Grid



Subdivision of the main gridlines in a graphical display using subgridlines.

Available in the graphics subsystems

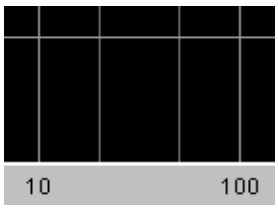
Sweep, FFT, Waveform

"Off" Subgridlines are deactivated.

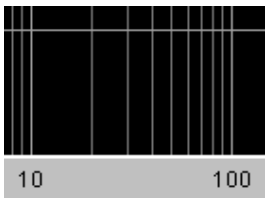
"2, 4, 5" With Spacing = Lin:
Subdivision of the main gridlines in a **linearly** divided x-axis into 2, 4 or 5 sections.
If, for example, **2** is selected, the y-axis is divided into two sections, i.e. **one** subgridline appears between the main gridlines.
These subgridlines are **not** hidden if the graphical window is reduced in size!

"Coarse, Fine"

With Spacing = Log:
Coarse or fine subdivision of the main gridlines of a **logarithmically** divided x-axis by subgridlines.



Coarse: Subgridline 2 and 5 only



Fine: All subgridlines

Show Title Show Leg A , Show Leg B

Permits or prevents the display of free texts in the graphical displays.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

"activated" Permits the display of free texts in the graphical displays.

"deactivated" Prevents the display of free texts in the graphical displays.

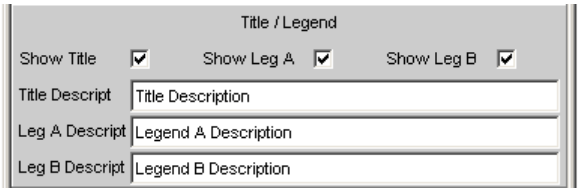
Remote command:

`DISPlay:SWEep<n2>:TITLe:SHOW` on page 764

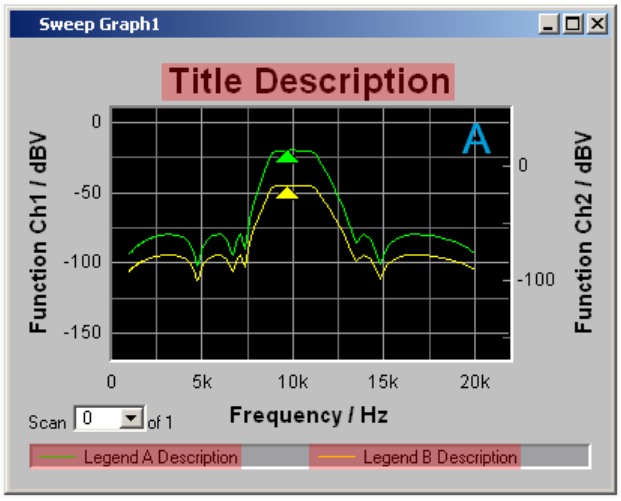
`DISPlay:SWEep<n2>:A:LEGend:SHOW` on page 755

`DISPlay:SWEep<n2>:B:LEGend:SHOW` on page 755

Title Descript, Leg A Descript, Leg B Descript



Input fields for free text for display in the graphical displays.



Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:TITLe:DESCription` on page 764

`DISPlay:SWEep<n2>:A:LEGend:DESCription` on page 755

`DISPlay:SWEep<n2>:B:LEGend:DESCription` on page 755

Store Trace as

This specifies the format in which the current trace is to be stored.

Depending on this setting, further command lines for modifying the data set that has to be stored are added or removed.

"Trace List" A trace is stored complete with all its scans, X and Y data, limit data and reference values.
This file can be loaded as a trace file at parameter field "Y-Source", File: Trace A or File: Trace B and can be displayed.
Available in the graphics subsystems
Sweep, FFT, Waveform, Bar Graph

"Equalization List" A trace is stored as an equalization file in order to make it available to the generator as a preemphasis file.
Each time an equalization file is stored the generator equalization file is loaded again, regardless of whether or not "Modify Equ. " is enabled. Then whenever a new equalization file is saved the precorrector becomes immediately effective on the next sweep scan.
If the name of the stored equalization file and of the equalization file used in the generator are not identical, a warning is issued to notify that the newly created equalization file will now be used in the generator.
Available in the graphics subsystems
Sweep, FFT

"Sweep List" A trace is stored as a sweep list.
If an "Auto List "– or "Manu List " Sweep is set in the generator, the sweep parameters are read from this file.
Available in the graphics subsystems
Sweep, FFT

"Limit List" A trace is stored as a limit list.
This file can be loaded at "Limit Upper" or "Limit Lower". It can then be displayed as a limit curve and used for limit monitoring.
Available in the graphics subsystems
Sweep, FFT, Bar Graph

"DataList Select" The filtered data of a trace is stored complete with all its scans, X and Y data, limit data and reference values.
Data filtering is set in the measured value list via softkey menu item "Selection".

The following filters can be selected:

- Upper limit violations only
- Lower limit violations only
- Upper and lower limit violations
- Harmonics only
- Peaks only.

A trace file stored in the "DataList Select" mode in conjunction with filters enabled in the measured value list usually consists of significantly fewer data sets than when unfiltered and the number of data sets for Trace A and Trace B is usually different.
Available in the graphics subsystems
Sweep, FFT, Bar Graph

Remote command:
`MMEMory:SWEep<n2>:STAS` on page 767

Trace

This is offered for "Store Trace as an" = "Equalization List" or "Limit List" and specifies whether the data set of Trace A or Trace B will be used for creating the corresponding lists.

Remote command:
`MMEMory:SWEep<n2>:TRACe` on page 768

Norm Freq

This is offered for "Store Trace as " = "Equalization List ".

This specifies the frequency whose voltage value is used for normalization. If the frequency selected is that at which the frequency response curve is at its maximum, the precorrector file contains only values from 0.0 to 1.0. If a different frequency is selected, factors greater than 1.0 also occur.

Remote command:
`MMEMory:SWEep<n2>:EQUalization:NORMfrequency` on page 767

Invert

This is offered for "Store Trace as " = "Equalization List ".

The effect of inverting the frequency response in the generator by means of an equalization file created with the "Invert" setting is that the same DUT - with the precorrector enabled - now receives an undistorted frequency response.

Application: Constant (i.e. frequency response independent) power output, preemphasis/deemphasis.

If there is **no** check in the box, the equalization data set that is acquired corresponds to the frequency response of the DUT.

If the DUT is removed and a generator sweep is carried out using this equalization data set, the DUT can be simulated since a frequency response arises as if the DUT were present.

Remote command:
`MMEMory:SWEep<n2>:EQUalization:INVert` on page 767

Modify Equ.

This is offered for "Store Trace as " = "Equalization List ".

The current generator equalization data set is taken into account when the new equalization list is stored in order to obtain a significantly more accurate precorrection.

What is the purpose of multistage preemphasis?

Example:

At high frequencies a loudspeaker frequency response has a roll-off of approx. 10 dB.

The intention is to compensate the frequency response by means of a generator pre-emphasis (equalization). For this purpose a generator sweep is started and the frequency response curve is acquired. An equalization file is created from this trace and made available to the generator. Another sweep is started using the equalization file and the frequency response is acquired.

The frequency response now seems considerably better, though the expected straight line has not appeared and there are inaccuracies in regions showing greater generator level increases.

The causes for this are **non-linearities** in the loudspeaker system. An increase in the generator level of 10 dB has not, as first expected, also increased the loudspeaker sound pressure by 10 dB but rather by only (for example) 9.8 dB due to non-linearities.

In order to compensate for these inaccuracies a further equalization using "Modify Equ. " can be performed. This second scan, based on the data set of the equalization file loaded in the generator, usually produces the expected flat frequency response.

If "Modify Equ. " is enabled and a new equalization file is created but equalization is not yet enabled in the generator, equalization is turned on by default using the newly created file name.

Remote command:
`MMEMory:SWEep<n2>:EQUalization:MODify` on page 767

Offset

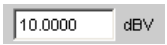
This is offered for "Store Trace as " = "Limit List ".

When a limit file is generated, an offset value is added to the Y data. This value is specified in the following parameter field.

Offset allows, for example, two limit files to be generated from a "golden unit", together forming a tolerance band, by generating a limit file for Upper Limit with an offset value of say 10 dBV and a limit file for Lower Limit with an offset value of -10 dBV. This produces a tolerance band with a width of 20 dBV so that the ideal frequency response of a selected DUT can be compared with the currently different DUT.

Remote command:
`MMEMory:SWEep<n2>:LIMit:OFFSet` on page 767

Offset Value



This is offered for "Store Trace as " = "Limit List ", if the "Offset " checkbox is activated.

It is an additive value for generating limit files based on the trace data set of an ideal DUT. Generating two limit files, one with a positive and the other with a negative offset, allows a tolerance band to be generated

Remote command:
`MMEMory:SWEep<n2>:LIMit:OFFSet:VALue` on page 767

Store Trace to

This stores the current trace, complete with all scans, in the format specified by Store Trace as, under the specified file name.

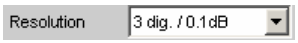
Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`MMEMory:SWEep<n2>:STORe` on page 768

Resolution



Used to set the number of digits used to display the cursor and scaling values in the graphical window.

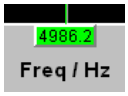
If "Engineering " is set to "Auto ", the Resolution setting only applies to the cursor values and not to the scale values.

Available in the graphics subsystems

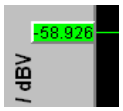
Sweep, FFT, Waveform, Bar Graph

"3 dig. / 0.1 dB, 4 dig. / 0.01 dB, 5 dig. / 0.001 dB, 6 dig. / 0.0001 dB, 7 dig. / 0.00001 dB"

Significance of the parameter list using an example:
5 dig. / 0.001 dB
5 dig.:
Values which are displayed with a linear unit (V, Hz, etc) are output with 5 digits:

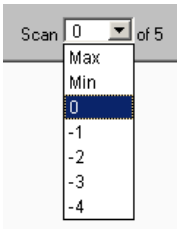


0.001 dB:
Values which are displayed with a logarithmic unit (dBV, dBu, etc.) are output to three decimal places:



If the numeric values can no longer be displayed with the selected resolution, they are rounded off and shown as an exponent:

Scan



This is a display for the current scan and an opportunity to select a scan in the graphical display. For those graphic systems that allow multiscan recording (Sweep Graph 1 to 4), the desired scan can be selected here. Number 0 means the most recent scan. The lower the negative number, the older the scan.

Scans identified as Min and Max are available to all graphic systems, provided they are enabled by

checking the box.

When you use the NEXT SCAN toggle key to scroll through the scans, the current value is entered here.

Available in the graphics subsystems

Sweep, FFT, Waveform, Bar Graph

Remote command:

`DISPlay:SWEep<n2>:SCANoffset` on page 710

5.43.4 Softkey Menu

Using an extensive softkey menu the display can be, among other things,

- automatically scaled (Autoscale)
- expanded (Zoom)
- measured using vertical and horizontal cursors (Cursor) or
- provided with markers (Marker).

Table 5-4: Explanation of the individual softkey menu items:

"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
"Trace "				
	"Show A" ☑			(Temporarily) show/hide graphical display of Trace A
	"Show B" ☑			Ditto for Trace B
	"Back "			Move back by one menu level
"Autoscale "				Single scaling of coordinate system using minimum and maximum values

"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
	"A"			For Trace A
	"B "			Ditto for Trace B
	"A&B "			Ditto for Trace A and B
	"X-axis "			Ditto for x-axis
	"All "			Ditto for Trace A, B, and x-axis
	"Back "			Move back by one menu level
"Cursor "				Cursor settings
	"O <--> X"			Used to determine whether O or X cursor is moved with rotary knob
	"O Cursor "			O cursor settings
		"O Active " ☑		Activate/deactivate O cursor
		"O Vert A "		O cursor becomes vertical cursor on Trace A
		"O Vert B "		Ditto on Trace B
		"O Vert A-B "		Ditto on Trace A and Trace B and shows difference between Y values.
		"O Hor A "		O cursor becomes horizontal cursor on Trace A
		"O Hor B "		Ditto on Trace B B
		"Movement (Next Pixel) "		Movement behavior of O cursor when it is moved
			"Next Pixel "	Pixel-by-pixel movement
			"Next Bin " "Next Sample " "Next Value " "Next Step "	Between reference points
			"Next Peak "	Movement between partial curve peaks
			"Next Harmonic "	FFT display: movement between harmonics
		"Back "		Move back by one menu level

"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
	"X-Cursor "			X cursor settings
		"X Active " ☑		Activate/deactivate X cursor
		"X Vert A "		X cursor becomes vertical cursor on Trace A
		"X Vert B "		Ditto on Trace B
		"X Vert A-B "		Ditto on Trace A and Trace B and shows difference between Y values.
		"X Hor A "		X cursor becomes horizontal cursor on Trace A
		"X Hor B "		Ditto on Trace B B
		"Movement (Next Pixel) "		Movement behavior of X cursor when it is moved
			"Next Pixel "	Pixel-by-pixel movement
			"Next Bin " "Next Sample " "Next Value " "Next Step "	Between reference points
			"Next Peak "	Movement between partial curve peaks
			"Next Harmonic "	FFT display: movement between harmonics
		"Back "		Move back by one menu level
	"Set O Cursor "			Sets O cursor …
		"Max "		… to trace maximum
		"Min "		… ditto for minimum
		"Marker A "		… to position of Marker A
		"Marker B "		... to position of Marker B
		"Value "		… to a value that can be entered later
		"Back "		Move back by one menu level
	"Set X Cursor "			Sets X cursor …
		"Max "		… to trace maximum
		"Min "		… ditto for minimum

"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
		"Marker A "		… to position of Marker A
		"Marker B "		... to position of Marker B
		"Value "		… to a value that can be entered later
		"Back "		Move back by one menu level
	"Back "			Move back by one menu level
"Marker "				Marker settings
	"Trace A "			Marker settings for Trace A
		"Off"		Marker deactivated
		"Set to O Cursor "		Set marker to position of O cursor
		"Set to X Cursor "		Set marker to position of X cursor
		"Set to Value "		Set marker to a value that can be entered later
		"Track to Max" ☑ ""		Set marker to maximum of Trace A. Marker changes with maximum
		"Harm " ☑		Harmonics are calculated and displayed based on X position of marker
		"Back "		Move back by one menu level
	"Trace B "			Marker settings for Trace B
		"Off"		Marker deactivated
		"Set to O Cursor "		Set marker to position of O cursor
		"Set to X Cursor "		Set marker to position of X cursor
		"Set to Value "		Set marker to a value that can be entered later

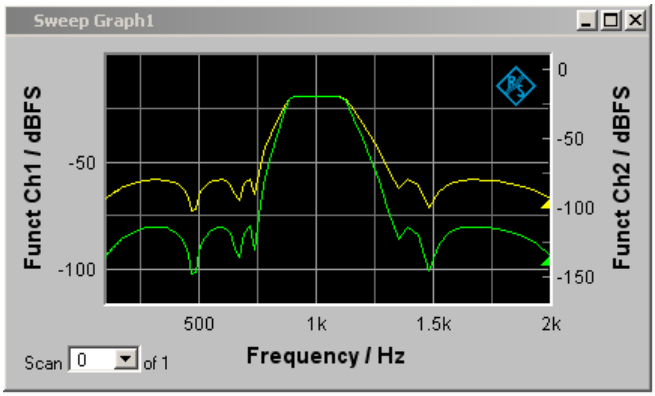
"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
		"Track to" Max ☑ ""		Set marker to maximum of Trace B. Marker changes with maximum
		"Harm " ☑		Harmonics are calculated and displayed based on X position of marker
		"Back "		Move back by one menu level
"Zoom "				Increase / reduce size of graphical display
	"Act Curs In "			Size of graphical display is increased around active cursor (solid line). If active cursor is a vertical cursor, a section of x-axis is displayed; if it is a horizontal cursor, a section of y-axis is displayed. In both cases, displayed section is adjusted so that cursor appears at center of display.
	"Act Curs Out "			Ditto for reducing size of graphical display
	"Betw V Curs "			Zooming between two vertical cursors
	"Betw H Curs "			Zooming between two horizontal cursors
	"Unzoom "			Undoes all zoom operations
	"Undo "			Undoes zoom operation last performed. Several zoom operations can be undone. Entering new axis limits (Top, Bottom, Left, Right) resets undo memory.
	"Autoscale "			Automatic scaling of coordinate system using minimum and maximum values
		"A"		For Trace A
		"B "		Ditto for Trace B
		"A&B "		Ditto for Trace A and B
		"X-axis "		Ditto for x-axis

"Level 1 "	"Level 2 "	"Level 3 "	"Level 4 "	Brief description
		"All "		Ditto for Trace A, B, and x-axis
		"Back "		Move back by one menu level
"Restart Min/Max " "Lim Violation "				Deletes Min/Max curves and limit violation symbols for graphical display and restarts collection of Min/Max data and checking of limit violations.
	"MinMax A "			Min/Max curves of Trace A
	"MinMax B "			Ditto for Trace B
	"MinMax A+B "			Ditto for Trace A and Trace B
	"Lim Viol A "			Limit violation symbols for Trace A, i.e. red dots which indicate limit violations on trace, and red triangular symbols for limit violations are deleted and only a gray triangle is displayed.
	"Lim Viol B "			Ditto for Trace B
	"Lim Viol A+B "			Ditto for Trace A and Trace B
	"Back "			Move back by one menu level
"Config "				Opens associated Config panel

5.43.5 Single Scan

For the two independent y-axes (Trace A and Trace B) on the graphical display, the user can display two out of eight simultaneously acquired measured values. These can include not only level measurement results, frequencies or total harmonic distortions from the left and right channels, but also physically different values such as voltage and phase. The measurement function relevant to the measured value display is set in the Analyzer Function panel, and the measurement function relevant to the trace display is selected from the Graphics Configuration panel at "Y-Source".

The graph shows a single sweep on Trace A (green) and Trace B (yellow).



In addition the setting

produces two further scans in which the Min and Max curves are generated, exactly as in the following graph which shows a crowded set of curves.

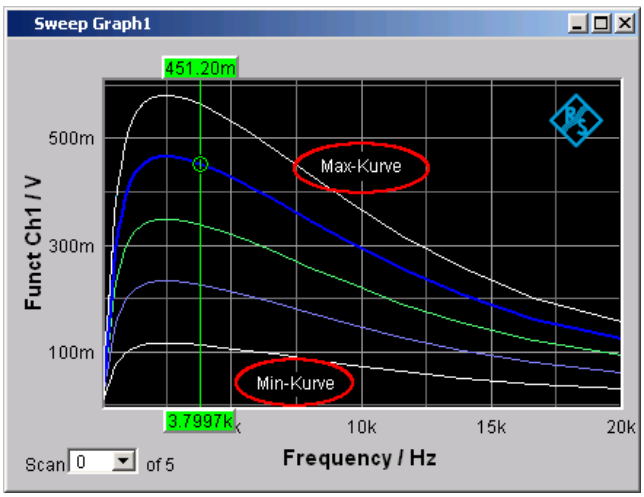
5.43.6 Trace Group

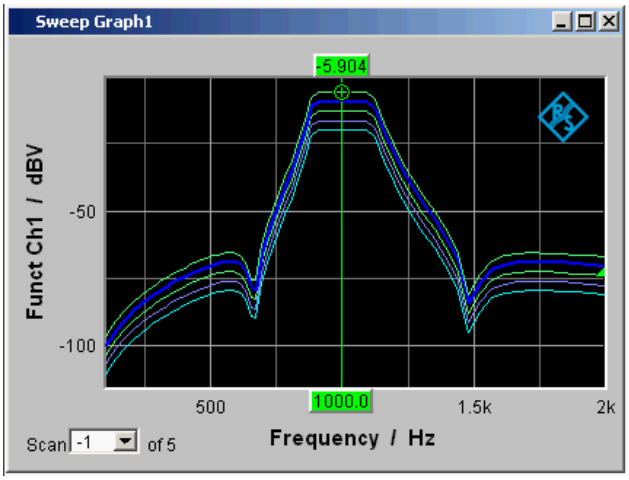
With the R&S UPP, the number of measurement sequences is not restricted to x number of scans. Instead, Sweep Graphs 1 to 4 can be set for the graphics system (see chapter 5.43.1, "Graphical Display, Explanation of the Elements", on page 477).

between 2 and 20 in the appropriate configuration panels. In addition the setting

produces two further scans in which the Min and Max curves are generated.

A trace group with Min/Max curves is shown as the graphical display.





All of the recorded measurement sequences are saved (both internally and, if the user requires, as a file) and can be displayed, rescaled and reloaded as a single unit.

With the generator, a second sweep (the Z sweep) is possible in addition to the X sweep. It is called the Z sweep because it is usually displayed on the z-axis of a 3D coordinate system. When this operating mode is selected, the number of scans set under "History" is automatically set to the number of Z-points.

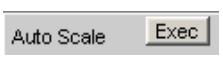
Generally, in a graphical window which allows scans to be recorded, a trace group or a trace pair consisting of Trace A and Trace B each with one trace group will be displayed in the respective graphical window if History is set to ≥2.

If History is set to the maximum value of 20 and "Show Min Max" is activated: a maximum of 44 scans are displayed

Trace A	20	Scans
Trace A	1	Min trace
Trace A	1	Max trace
Trace B	20	Scans
Trace B	1	Min trace
Trace B	1	Max trace
-------	----	----------
total	44	Traces

As long as a measurement is running and scans are performed, they are displayed in gray. When the measurement is completed or the scan was stopped by means of Hold, the scans are displayed in automatically assigned colors.

In the case of automatic scaling of the y-axis



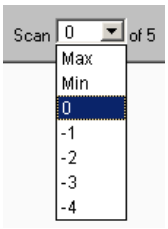
all available traces are taken into account in order to determine the maxima and minima.

All other actions, e.g. setting the cursor to the Min or Max value, always relate to the current scan. For limit violation monitoring, which is set up using

all traces are checked against the same two limit curves. The symbol for limit violation

always relates to the current trace pair.

The current scan (one trace if only Trace A or Trace B is activated, two traces if both traces are activated) is changed in the graphical window or result list using the NEXT SCAN toggle key or the selection field.



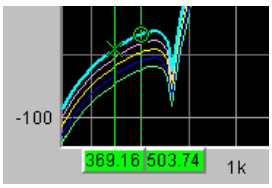
The number in the "Scan" selection field

displays for graphic systems that allow multiscan recording (Sweep Graph 1 to 4) the current value, the so-called scan index. Number 0 means the most recent scan. The lower the negative number, the older the scan.

Scans identified as Min and Max are available to all graphic systems, provided they

are activated.

If Cursor is switched on in the graph, an O or X identifies the intersection of the cursor with the current trace or trace pair. If the scan index changes, this marking jumps to the next scan.



If the measured value list is enabled,

the lists are reconfigured after every change in the scan index, because only one scan is displayed in the measured value list.

5.43.7 Interpolation on the Common x-axis

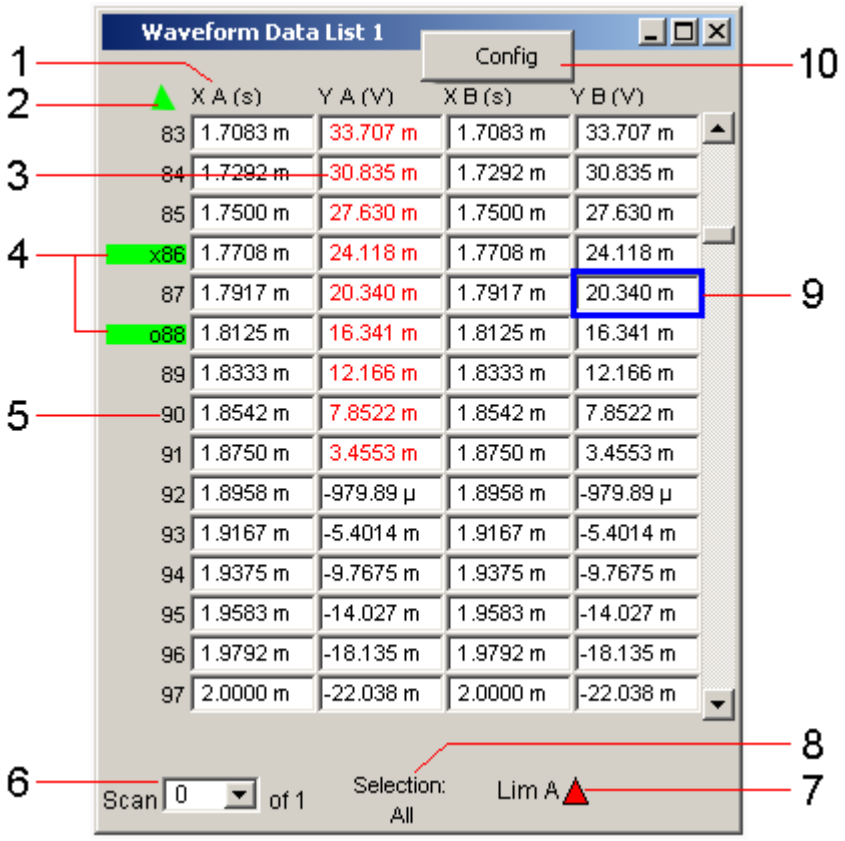
So that any number of traces can be used as reference or displayed simultaneously for comparison and measured with the cursors, such traces should actually all have the same X values. The R&S UPP, however, can use any X divisions, by interpolating the measured value sequences, reference traces and limit curves onto the current x-axis. The Equalization Lists are also interpolated on the x-axis of the generator sweep and the waiting time curves for sweep stepping.

Reference traces, limit curves and waiting time curves therefore need consist of only a few interpolation points. The interpolation takes into account whether the x and y-axes are divided on a linear or logarithmic basis, because segments of ellipses are generally produced from straight lines in the other display.

5.44 Result List

All measured values from all graphic subsystems can also be displayed in lists instead or in combination with the graphical windows.

5.44.1 Graphical Display, Explanation of the Elements

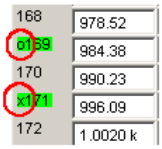


1: Columns with measured values
Trace A, Trace B and the associated x-axes are displayed as numeric values in a maximum of four columns.

2: Arrow
Colored arrow symbols indicate the direction in which a cursor left the display window.

3: Measured value with limit violation
A limit violation, which is identified by red dots / red bars on the traces and bar graphs, is indicated by red measured values in the result list.

4: Cursor markers
A colored rectangular marking indicates the row containing the value at which the cursor is located (also applies to traces and bar graphs). "o" or "x" to the left of the measurement number indicates the O or X cursor.



Pressing the "Find Cursor "softkey adjusts the display window so that the data set appears together with the cursor at the center of the display.

5: Numbering of measured values
The individual measured values are numbered consecutively from 1 to n.

6: Scan number
If a trace consists of several scans, the desired scan can be selected here by pressing the NEXT SCAN rocker key or using the mouse. In the result list, only the values of the selected scans are shown. The scan number shown in this display field indicates which scan is listed.

7: Symbols indicating limit violations

"Limit Upper" △
Limit Upper is activated and there is no limit violation.

"Limit Lower" ▽
Limit Lower is activated and there is no limit violation.

"Limit Upper past" ▲
The "Limit Upper" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Lower past"

The "Limit Lower" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Upper current"

The "Limit Upper" value is currently being violated.

"Limit Lower current"

The "Limit Lower" value is currently being violated.

8: Display filter
If the result list has the focus, a softkey menu appears. Pressing the "Selection " button opens the next softkey level where it is possible to select the measured values according to the following criteria, i.e. to list only those rows which satisfy the selection criteria:

"All ", "Lim upper ", "Lim lower ", "Lim upp&low ", "Harmonics ", "Peaks "

9: Selection frame
Used to scroll through the result list. When the selection frame reaches the top or bottom of the result list, the list is scrolled below the window.

10: Config
Right-clicking anywhere opens a context menu, left-clicking opens the corresponding DispConfig panel.

5.44.2 Calling Up

A data list button can be found in the first line of every display configuration panel

and can be used to open a measured value list for each graphic system or for additional graphic display.

Trace A, Trace B and the associated x-axes are displayed as numeric values in a maximum of four columns.

The column on the left-hand side contains the number of the measured value, a colored marking indicating the row containing the value at which the cursor is located and may also contain colored arrow symbols indicating the direction in which a cursor left the display window. Pressing the "Find Cursor " softkey adjusts the display window so that the data set appears together with the cursor at the center of the display.

In the columns for the Y values of Trace A and Trace B digits highlighted in color by pressing the "Selection" softkey indicate whether the measurement result is violating the "Limit Upper" and/or "Limit Lower" parameters or whether the value is a harmonic or a peak.

Hidden sections of the data set can be shown in the display window using the scrollbar on the right-hand side of the panel or using the blue selection frame.

5.44.3 Parameter Fields of the Panel

The result list does not have its own panel; it is configured according to the settings in the display configuration panel from which it was opened.

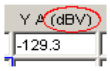
The following parameter fields and softkey functions affect the result list (and, at the same time, the traces and bar graphs):

Unit Funct Track

Used to determine whether the unit is the same as that set in the analyzer or whether it can be user-selected.

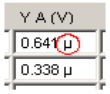
Unit

The unit set here is displayed above the measurement result column for Trace A, Trace B or above the values on the x-axis:



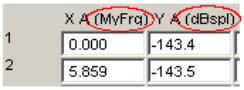
Engineering

The measured values for Trace A oder Trace B and the values on the x-axis are displayed with the engineering selected in this parameter field:



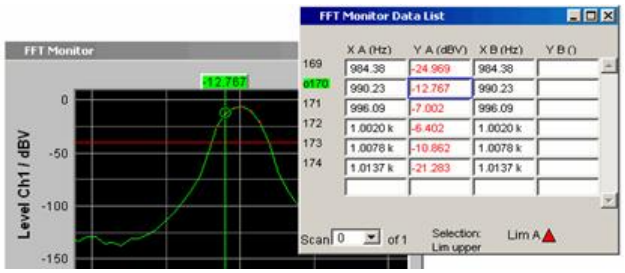
Unit Auto

Used to determine whether the unit label displayed above the measurement result column for Trace A, Trace B or above the values on the x-axis is the same as the unit set in the "Unit Funct Track" or Unit parameter field, or whether it can be user-selected.



Limit Upper

If a "Limit Upper" value or scan is set here, the measured values which violate the limit are displayed in red if "Limit Upper" or "LimUpp&Low" is set under the "Selection" softkey.

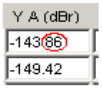


Limit Lower

If a "Limit Lower" value or scan is set here, the measured values which violate the limit are displayed in red if "Limit Lower" or "LimUpp&Low" is set under the "Selection" softkey.

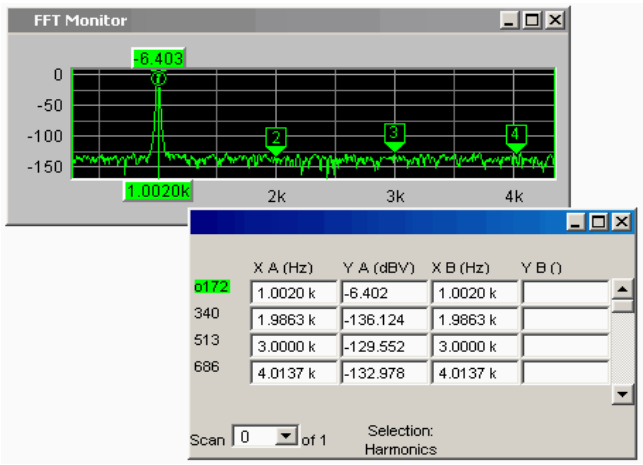
Resolution

Used to set the number of digits used to display the measurement results for Trace A and Trace B and the values on the x-axis.



Selection Harmonics

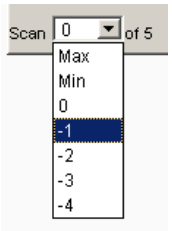
If harmonics are shown in the graphical display (activated using the softkey menu), a display filter which only shows the values of the harmonics can be applied to the list display by setting "Harmonics " under the "Selection " softkey. There are gaps in the numbering of the values on the left side of the window.



Scan

This field and option in the graphical display also appears in the result list. It indicates the selected scan for Sweep Graph 1 to 4 graphic subsystems which have multi-scan recording.

The current value for the respective scan is entered here by scrolling through the scans using the NEXT SCAN key; this value can then be changed.



Number 0 means the most recent scan. The lower the negative number, the older the scan.

5.44.4 Softkey Menu

Explanation of the individual menu items:

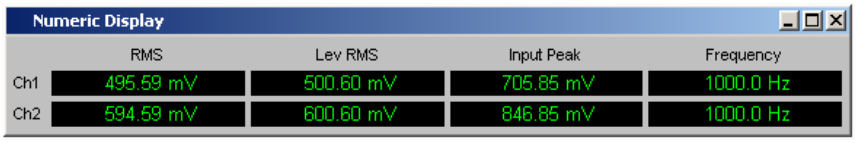
Level 1	Level 2	Brief description
"Close "		Used to close the result list.
"Find Cursor "		Used to adjust the display window containing the result list so that the data set appears together with the cursor at the center of the display. If both cursors are activated, this button is used to toggle between the two cursors.

Level 1	Level 2	Brief description
"Selection " Remote control command: `DISPlay:SWEep<n2>:DLISt:FILTer` on page 762		The following values are listed in the result list:
	"All "	All
	"Lim upper "	Only those values which over-range the upper limit
	"Lim lower "	Only those values which under-range the lower limit
	"Lim upp&low "	Only those values which over-range the upper limit and under-range the lower limit
	"Harmonics "	Only harmonics
	"Peaks "	Partial trace maxima

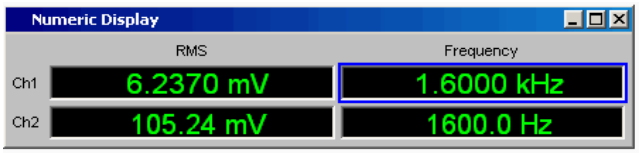
5.45 Numeric display

The numeric display provides a clear overview of max. 8 measurement results (two-channel instruments) or max. 32 measurement results (multichannel instruments) from max. four analyzer measurement functions from the Analyzer Function panel. If all of the analyzer measurement functions are activated, the individual columns are assigned the measurement functions in the following sequence (from left to right):

Measurement results for Analyzer Function, Level Monitor, Input Monitor, Freq/Phase.



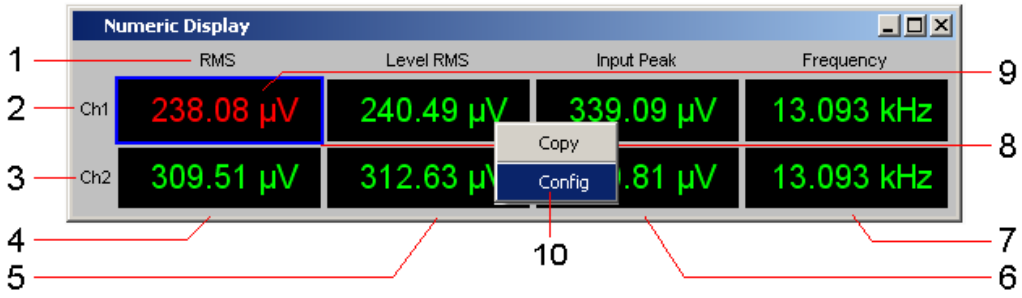
If certain analyzer measurement functions in the Analyzer Function panel are deactivated, the associated measurement results are hidden. The name of the measurement function, however, clearly indicates which column refers to which measurement function.



For more detailed information on the assignment of the individual measurement results to the analyzer measurement functions see chapter 5.46, "Combo Display", on page 555).

5.45.1 Graphical Display, Explanation of the Elements

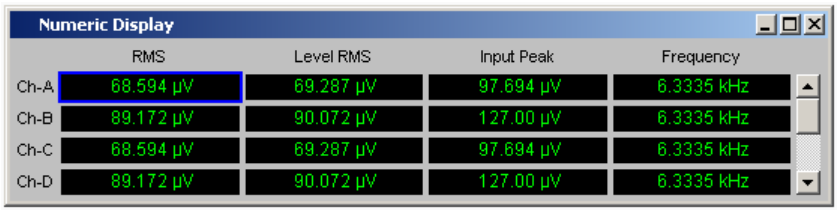
The explanation of the elements is based on the numeric display for two-channel instruments.



For analog analyzers the only difference are the additional lines Ch3 to Ch8.

The number of simultaneously displayed channels can be set for multichannel instrument in the Config panel in the panel section "Numeric Display Configuration" with the "Max Ch Disp" parameter field. The remaining channels can be reached via the scrollbar.

The labeling of the display fields is generally Ch1, Ch2, Ch3, etc., but it can be changed with the "Channel Descr." parameter field. The respective string is called: "**Ch-A;;Ch-B;;Ch-C;;Ch-D**;;Ch5;;Ch6;;Ch7;;Ch8;;Ch9;;Ch10;;Ch11;;Ch12;;Ch13;;Ch14;;Ch15;;Ch16".



1: Name of measurement function
Name of the current measurement function from left to right:

Function, Level Monitor, Input Monitor, Freq/Phase

If the measurement function is changed in the analyzer panel, the labels here also change.

2, 3: Measurement result for Channel 1, Measurement result for Channel 2
In the sequence specified above.

4: Measurement result function, column 1
Measurement results of the function which is set in the **Analyzer Function** in the "Function" field.

5: Measurement result for Level Monitor, column 2
Measurement results for the set **Level Monitor** function.

6: Measurement result for Input Monitor, column 3
Measurement results for the **Input Monitor** function.

7: Measurement result for the Freq/Phase measurement function, column 4
Measurement result for the Freq/Phase measurement function.

With the setting "Frequency" or "Sample Freq" either display of the frequency measurement result or with the setting of **Freq & Phase**-, **Freq & GrpDel** or **Freq & Samplefreq** display of the frequency measurement result in the first row and display of phase, group delay or sample frequency measurement result in the second and, if necessary, following rows.

8: Selection frame
If the numeric display has the focus, measurement results can be selected by moving the blue selection frame with the rotary knob or by clicking with the mouse. Double-clicking with the mouse opens the associated combo display (see chapter 5.46, "Combo Display", on page 555).

9: Limit violation display

Measurement result displayed in green:

Limit monitoring is deactivated or the measurement result is within the preset limits.

Measurement result displayed in red: Current limit value violation is present. For setting the limit values, see chapter 5.46, "Combo Display", on page 555).

The measurement is deactivated in the analyzer panel.

No measurement result is available (yet).

10: Copy / Config
Right-clicking anywhere calls up a context menu, left-clicking on one of the entries executes the corresponding function.

Copy:

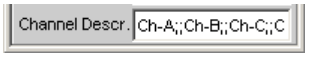
Copies measured value and unit as ASCII character string to the clipboard (same as CTRL+C).

Config:

Opens the corresponding DispConfig panel.

Max Ch Disp
The number of simultaneously displayed channels can be set for multichannel instrument using the button "Utilities", "Config Panel" in the panel section "Numeric Display Configuration" in the parameter field "Max Ch Disp", see "Max Ch Disp" on page 475

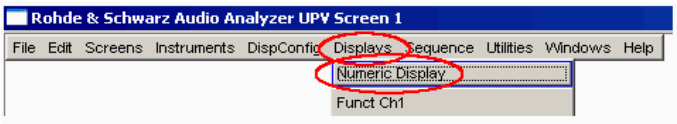
Channel Descr.



The labeling of the display rows in the Numeric Display can be entered via the menu bar under the button "Utilities", "Config Panel" in the panel section "Numeric Display Configuration" in the parameter field "Channel Descr.", see "Channel Descr." on page 475

5.45.2 Calling Up

The numeric display field is opened via the menu bar.


Rohde & Schwarz Audio Analyzer UPY Screen 1
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Numeric Display
Funct Ch1

5.45.3 Parameter Fields of the Panel

The numeric display does not have its own panel; however, a number of settings made in the measurement result configuration panels in the combo displays affect the way in which the measurement results are displayed:

Unit

Unit Auto

Resolution

Engineering

Reference

Limit Lower

Limit Upper

For more detailed information see chapter 5.46, "Combo Display", on page 555).

5.45.4 Softkey Menu

The numeric display does not have its own softkey menu; however, the softkey functions of the combo displays affect the way in which the measurement results are displayed.

For more detailed information see chapter 5.46, "Combo Display", on page 555).

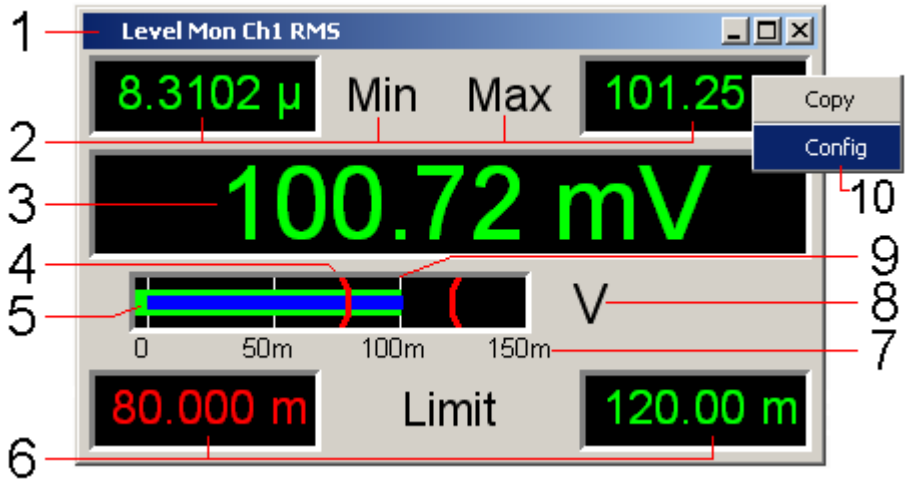
5.46 Combo Display

It is often the case that the measurement results in the numeric display do not contain adequate information. Additional features such as analog bar graphs, limit monitoring or the storage of maximum and minimum values are frequently required.

The combo display is used for this purpose. Additional information can be displayed for every measurement shown in the numeric display.

The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the R&S UPP screen from a relatively long distance.

5.46.1 Graphical Display, Explanation of the Elements



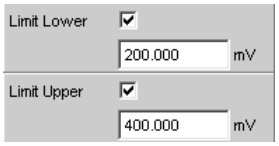
1: Measuring function
Measuring function in the combo display title field

2: Minimum value / maximum value
Highest/lowest value measured since the START key was pressed; set with

3: Measurement display
Current measured value.

If the measured value changes to red, there is a limit violation.

4: Limit marker
Displays the



lower and upper limit specified under in the bar graph.

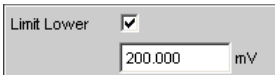
5: Bar Graph
Green:

Displays the measurement result as a bar on a scale. If the bar changes to red, there is a limit violation.

Blue:

Min/Max bar graph The ends of the blue bar indicate the lowest and highest measured value since the START

6: Lower / Upper Limit
Displays the

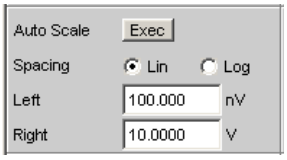


specified lower/upper limit numerically.

If the value changes to red,

this means that a violation of the lower/upper limit occurred after the START key was pressed. This limit violation is indicated until the hold function is reset by pressing the START key again or by entering a new lower/upper limit.

7: Scaling
Measurement range of the bar graph; set with



8: Unit
Unit of the bar graph; set with

9: Main grid, subgrid
Main grid and subgrid; set with

10: Copy / Config
Right-clicking anywhere calls up a context menu, left-clicking on one of the entries executes the corresponding function.

Copy:

Copies measured value and unit as ASCII character string to the clipboard (same as CTRL+C).

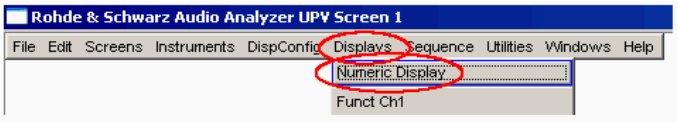
Config:

Opens the corresponding DispConfig panel.

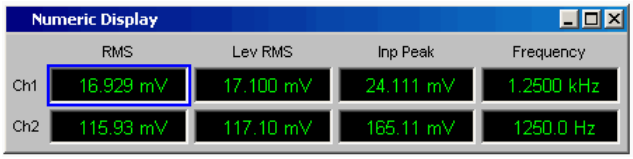
5.46.2 Calling Up

There are several ways to open the combo display:

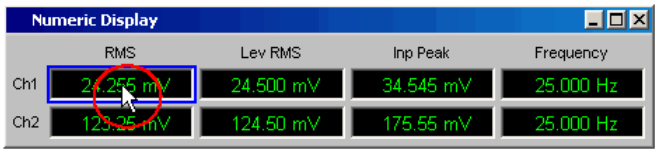
- Open the Display menu.


Rohde & Schwarz Audio Analyzer UPV Screen 1
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Numeric Display
Funct Ch1

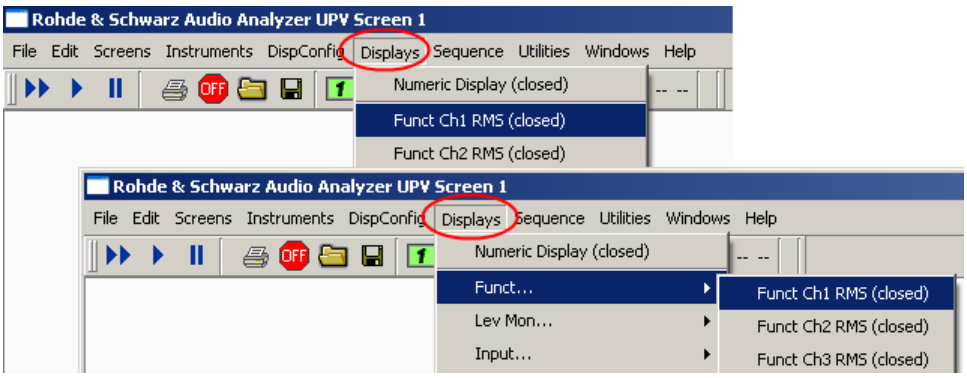
Select the Numeric Display menu item.



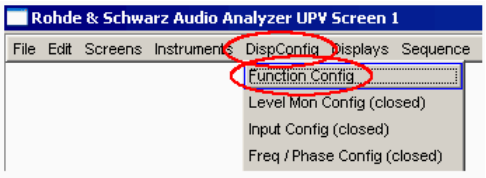
Double-click the desired measurement result in the numeric display.



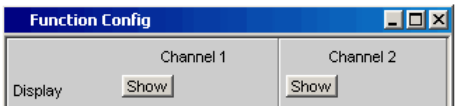
- Open the combo display directly via the menu bar.
  The menus differ slightly in two-channel or multichannel instruments.


Rohde & Schwarz Audio Analyzer UPV Screen 1
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Numeric Display (closed)
Funct Ch1 RMS (closed)
Funct Ch2 RMS (closed)
Rohde & Schwarz Audio Analyzer UPV Screen 1
File Edit Screens Instruments DispConfig Displays Sequence Utilities Windows Help
Numeric Display (closed)
Funct...
Lev Mon...
Input...
Funct Ch1 RMS (closed)
Funct Ch2 RMS (closed)
Funct Ch3 RMS (closed)

- Select a measurement result configuration panel from the menu field as follows:


Rohde & Schwarz Audio Analyzer UPV Screen 1
File Edit Screens Instruments DispConfig Displays Sequence
Function Config
Level Mon Config (closed)
Input Config (closed)
Freq / Phase Config (closed)

Click the "Show " button in the Display field of the configuration panel (possible only for two-channel instruments).



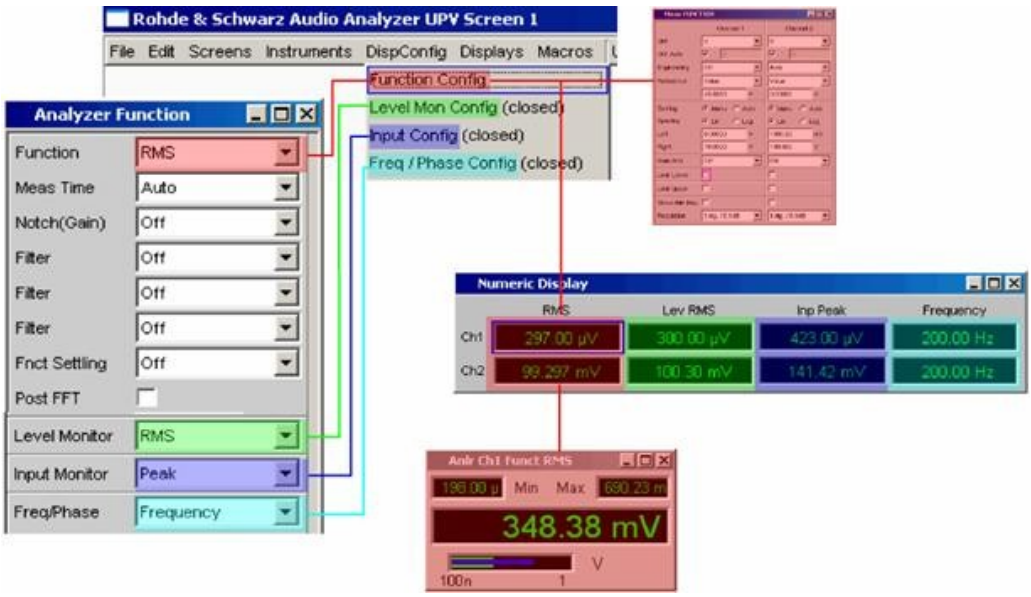
The measurement result configuration panels are used to determine how measurement results are **displayed** in the numeric display and the combo display.**What is measured and how measurement is performed** is configured in the analyzer panel.

The measurement result configuration panels are opened in the menu.

4 different measurement result configuration panels are available.

- **Function Config**
  The panel is used to configure how the measurement results for the analyzer measurement function "Function" are displayed.
- **Level Mon Config**
  The panel is used to configure how the measurement results for the additional measurement function "Level Monitor" are displayed.
- **Input Config**
  The panel is used to configure how the measurement results for the additional measurement function "Input Peak" are displayed.
- **Freq / Phase Config**
  The panel is used to configure how the measurement results for the additional measurement function "Freq/Phase" are displayed.

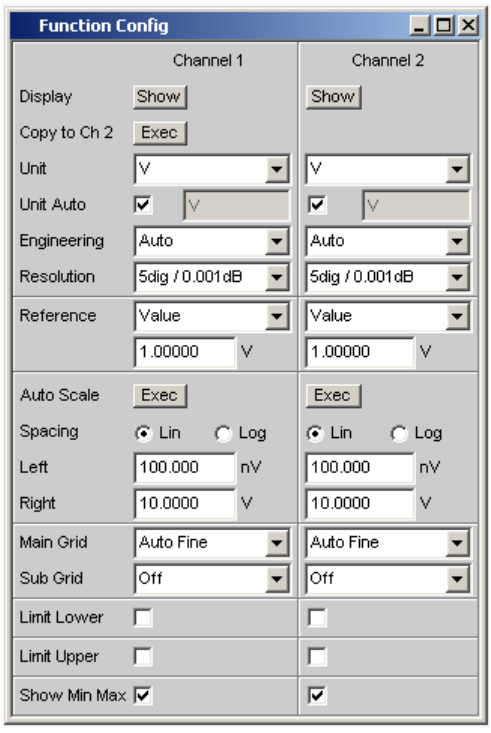
The illustration below shows the assignment of the analyzer measurement functions to the measurement result configuration panels and the measurement result displays.



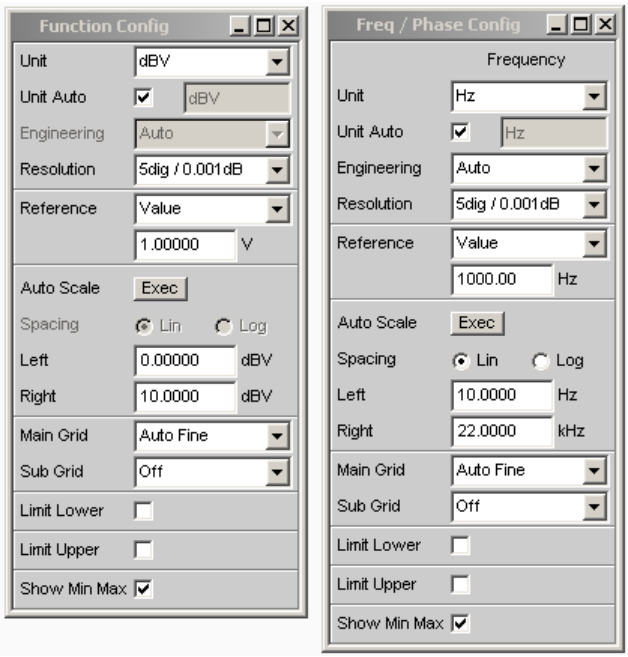
5.46.3 Parameter Fields of the Panel

The layout of the measurement result configuration panels is almost identical for all of the displays. The differences are explained in the respective setting function description.

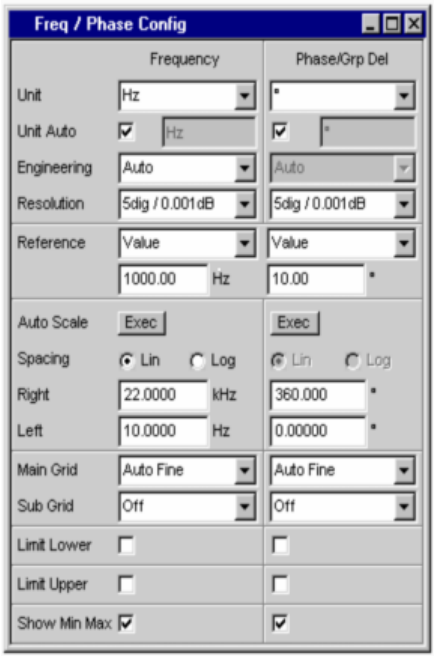
For **two-channel instruments**, channel 1 and channel 2 can be configured separately for each measurement function. For this reason, both columns are always provided for the Function, Level Monitor and Input Peak measurement results.



For the configuration of the measurement result displays of Function, Level Monitor and Input Monitor in the case of **multichannel instruments**, all channels are configured fully identically, therefore, only one column is provided. For **two and multichannel instruments**, the configuration panel of the pure frequency measurement always has one column.



For **two and multichannel instruments**, the configuration panel for the Freq/Phase measurement results in operating mode "Freq & Phase" and "Freq & Grp Del" always features two columns.



Display

Only for two-channel instruments:

Clicking the Show button activates the combo display for a measured value.

To close it, provided it has the focus, click on the CLOSE button or on the X in the title bar .

Copy to Ch2

Only for two-channel instruments:

The "Copy to Ch2" function exists for two-channel measurements for the "Function Config," "Level Mon Config" and "Input Config" measurement result configuration panels.

As the name says, the setting lines from the first channel are transferred to the second channel. This happens **once** for almost all setting lines when the Exec button is pressed.

In the Freq/Phase configuration panel this parameter field is not available, as the transfer of frequency setting lines makes no sense in the phase area.

Remote command:

`SENSe<n1>:CONFig:COPYother` on page 768

Unit

This parameter field is used to determine the unit in which the measurement results are to be displayed.

The parameter list available in this parameter field depends on whether the analog or digital analyzer instrument has been selected and under which of the 4 analyzer measurement functions the panel was opened.

- Function
- Level Monitor
- Input measurement
- Frequency/phase measurement

Approx. 30 different units are available to allow all measurement functions of the analyzer to be displayed.

If a logarithmic unit (dBu, dBV, dBr, dBm, dBFS) is selected, or a linear unit in which negative numbers can occur (e.g. ΔV, ΔW), the following parameter field "Spacing" is displayed as not user-accessible and its parameter is set to "Lin" since it makes no sense to display measured values with a logarithmic unit or negative values on a logarithmically scaled axis.

Remote command:

`SENSe<n1>:UNIT<n2>` on page 776

`SENSe3:FREQuency:UNIT` on page 771

`SENSe3:PHASe:UNIT` on page 774

Unit Auto
Used to determine whether the unit label displayed in the numeric display and in the combo display is the same as that set in the Unit parameter field above or whether it can be user-selected.

"activated"

The unit label displayed in the numeric display and in the combo display is the same as the unit set in the Unit parameter field and is therefore generated automatically by the R&S UPP.

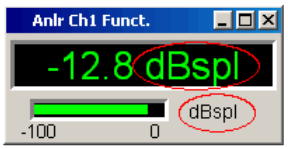
"deactivated"

A user-defined unit label can be entered.

Example:

The output level U0dBspl which is output at a sound pressure of 0 dBspl (spl = Sound pressure level) is specified for high-quality microphones.

If the measured microphone output level is displayed in the referenced unit dBr and entered for the reference value U0dBspl, the level displayed on the R&S UPP will be in dBr, but corresponds to the sound pressure in dBspl. A numeric value using the unit dBspl would be desirable in the measurement result display. To allow this, the unit label can be changed from dBr to dBspl.



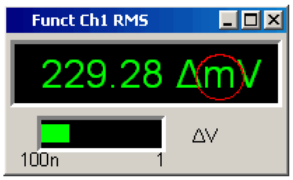
Remote command:
SENSe<n1>:UNAuto<n2> on page 775
SENSe<n1>:USERunit<n2> on page 776
SENSe3:FREQuency:UNAuto on page 771
SENSe3:FREQuency:USERunit on page 771
SENSe3:PHASe:UNAuto on page 774
SENSe3:PHASe:USERunit on page 774

Engineering

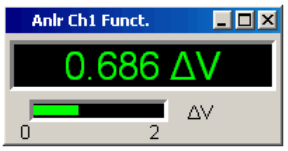
Computes the measurement results in the numeric display field and in the combo display using a power of ten that is divisible by three.

This parameter field cannot be accessed if a dB or % unit is selected in the Unit parameter field above since these units do not usually have an engineering function.

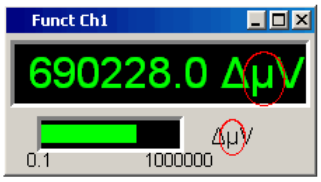
"Auto" **Automatic** engineering assignment from p to M, for the measurement result, limits and Min/Max values; depends on the magnitude of the respective value.



"Off" **No** Engineering.
Measurement result, limits and Min/Max values are always displayed in format 1.0 E^0



"µ, m, k" Engineering fixed to µ, m or k.
The values to be displayed are multiplied by the factor 1.0 E^6, 1.0 E^3 or 1.0 E^{-3}.
Measurement results, limits and Min/Max values are displayed with the selected engineering.



Resolution

Used to set the number of digits used to display the measurement result, limits and Min/Max values.

"<resolution>" "x dig. / x dB"
Significance of the parameter list using an example:
5 dig. / 0.001 dB
5 dig.:
Values which are displayed with a linear unit (V, Hz, etc) are output with 5 digits:

0.001 dB:
Values which are displayed with a logarithmic unit (dBV, dBu, etc.) are output to three decimal places:

If the numerical values can no longer be displayed with the selected resolution (e.g. because the number of places is too high with the selected engineering setting) the display is rounded in exponential style:

Reference

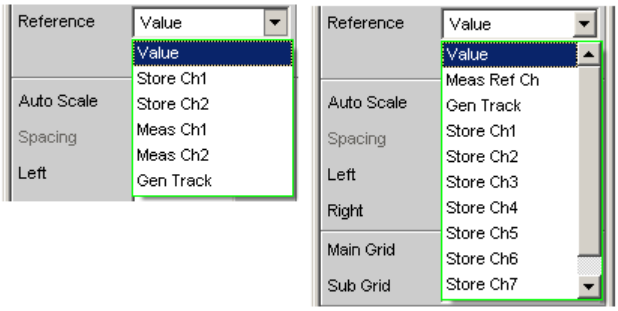
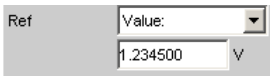


Fig. 5-27: Reference menu for two and multichannel instruments

Used to select the reference for referenced units for the measurement result.

"Value " A numeric value with unit must be entered as the reference value in the parameter field below.



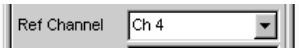
Note: If manual switchover is made from a variable reference value (Meas Ch1, Meas Ch2, Gen Track) to Value, the fixed reference value (Value) last valid will be restored.

"Store" The current measurement result of a single-channel measurement is stored under Value when the ENTER key is pressed or the mouse key is clicked; this measurement result is then displayed as the new reference value. The reference value does not change while measurements are being performed. This option is only available for 1-channel measurement.

"Store Ch1 ... " The current measurement result for the specified channel is stored under Value when the ENTER key is pressed or the mouse key is clicked; this measurement result is then displayed as the new reference value. The reference value does not change while measurements are being performed. These options are only available for two-channel or multichannel measurement.

"Meas Ch1, Meas Ch2 "
These options are only available for two-channel measurement. Each level measured value of channel 1 or channel 2 is stored as the reference value. If a referenced unit is selected in the "Unit" parameter field, the measurement result is referenced to this variable reference value and displayed.

"Meas Ref Ch" This option is only available for multichannel instruments.
Every level measurement result of the channel specified in the Analyzer Config panel under "Ref Channel "



is saved as a reference value. If a referenced unit is selected in the Unit parameter field, the measurement result is referenced to this variable reference value and displayed.

"Gen Track" The currently valid and every newly set generator voltage is stored as the reference value and can then be used for referenced display (by all channels). If a referenced unit has been selected in the "Unit " parameter field, the measurement result is referenced to this variable reference value and displayed.

Remote command:
SENSe<n1>:REFerence<n2>:MODE<n3> on page 775
SENSe3:FREQuency:REFerence:MODE on page 770
SENSe3:PHASe:REFerence:MODE on page 774
SENSe<n1>:REFerence<n2> on page 775
SENSe3:GROupdelay:REFerence on page 771
SENSe3:FREQuency:REFerence on page 770
SENSe3:PHASe:REFerence on page 773

Auto Scale

One-off automatic scaling of the bar graph.

"Exec" Clicking this button triggers a **once-only** scaling of the bar graph; the current minimum and maximum values are used for the scaling process.
The determined values are entered in the "Left " and "Right " parameter fields below.
For multichannel instruments the **lowest minimum value** and the **highest maximum value of all open combo displays** is determined and taken over for all channels in the following parameter fields, "Left" and "Right".

Spacing

Linear or logarithmic spacing of the bar graph.

"Lin" Linear spacing of the bar graph.
If a logarithmic unit (dB unit) was selected in the "Unit " parameter field, this field is displayed as not user-accessible and is set to "Lin " since it makes no sense / is not possible to use a logarithmic bar graph to display negative values, or measured values that have a logarithmic unit.

"Log" Logarithmic spacing of the bar graph.
This parameter is only available if a linear unit (V, W, etc) has been selected in the "Unit " parameter field and its value range cannot contain negative numbers.

Example:

Although ΔV is a linear unit, the measurement results can be negative, which means that logarithmic display is not possible.

Left

Used to set the left-hand value on the bar graph.

Negative values or the value 0.00000 are not allowed when "Spacing" = "Log", in which case they cannot be entered.

Remote command:
`SENSe<n1>:LEFT<n2>` on page 772
`SENSe3:FREQuency:LEFT` on page 769
`SENSe3:PHASe:LEFT` on page 772

Right

Used to set the right-hand value on the bar graph.

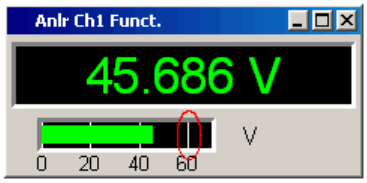
This value must always be higher than the Left value.

Negative values or the value 0.00000 are not allowed when "Spacing" = "Log", in which case they cannot be entered.

Remote command:
SENSe<n1>:RIGHt<n2> on page 775
SENSe3:FREQuency:RIGHt on page 771
SENSe3:PHASe:RIGHt on page 774

Main Grid

Division of the bar graph with vertical main lines.



"Off" No main lines are used in the bar graph.

"On" With the setting "Spacing" = "Log":
Decadic division of a **logarithmically** scaled bar graph with main lines.

"Auto Coarse, Auto Medium, Auto Fine"
With the setting "Spacing" = "Lin":
Coarse, medium or fine division of a bar graph with main lines. One to two, 3 to 4 or 8 to 9 main lines are displayed depending on the scale end values.
Main lines may be **hidden** if the combo display is reduced in size.

"Divisions" With the setting "Spacing" = "Lin":
Preset division of a bar graph with main lines.
The desired number of divisions is set in the parameter field below.
These sublines are **not** hidden if the combo display is reduced in size.

"Steps" With the setting "Spacing" = "Lin":
Preset division of a bar graph with linear scaling in a fixed step size.
The step size is set in the parameter field below.
These sublines are **not** hidden if the combo display is reduced in size.

Division

With the setting "Spacing" = "Lin":

Used to enter the number of main line divisions for a bar graph with linear scaling.

If, for example, 2 is entered, the bar graph is divided into **two** sections, i.e. **one** main line is displayed.

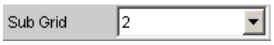
Step

With the setting "Spacing" = "Lin":

Used to enter the main line step size for a bar graph with linear scaling.

The unit of the value is not linked to the unit selected in the "Unit " parameter field; the value can be given in different units.

Sub Grid



Subdivision of the main lines in a bar graph using sublines.

"Off" Sublines are deactivated.

"2, 4,5" With the setting "Spacing" = "Lin":
Subdivision of the main lines of a **linearly** divided bar graph into 2, 4 or 5 sections.
If, for example, **2** is selected, the area between two main gridlines is divided into **2** sections, i.e. **one** subgridline appears between the main gridlines.
These sublines are **not** hidden if the combo display is reduced in size.

"Coarse, Fine "
With the setting "Spacing" = "Log":
Coarse or fine subdivision of the main lines of a **logarithmically** scaled bar graph with sublines.

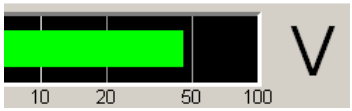


Fig. 5-28: Coarse: Sublines 2 and 5 only

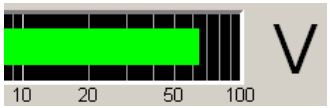


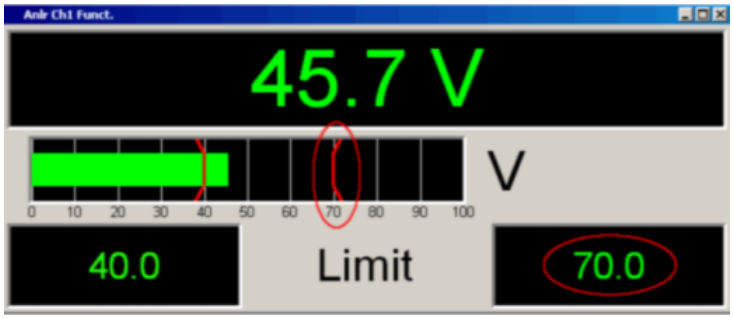
Fig. 5-29: Fine: All sublines

Limit Lower

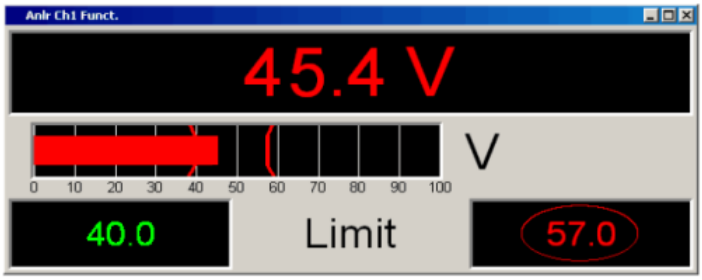
Used to activate/deactivate the lower limit check.

"activated" The lower limit check is activated.
The parameter field below is used to enter a lower limit in the unit selected in the Unit parameter field.

A lower limit can be defined for the measurement result; every measured value is then compared with this limit.
If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.
The lower limit is displayed as a value (bottom left) and as a red limit marker in the bar graph.



As soon as a limit is underranged, the measurement result and bar graph change from green to red; if the limit violation no longer exists, the measurement result and bar graph are displayed in green again.
A red measured value in the numeric display also indicates a limit violation:
In order to monitor limit violations over a long period of time without having to watch the measurement result display continuously, the lower limit is displayed permanently in red as soon as the limit is underranged after the START key has been pressed.



START key or re-entering the limit resets the hold function.
This hold function is not visible in the numeric display.

"deactivated" The lower limit check is deactivated.

Remote command:

SENSe<n1>:LIMLower<n2> on page 772

SENSe<n1>:LIMLower<n2>:VALue on page 772

SENSe<n1>: <n1> = 1| 2 | 6 (function measurements | Input Monitor | Level Monitor) ;
LIMLower<ch>: <ch>= 1 | 2 (2 for two-channel instruments only)

SENSe3:FREQuency:LIMLower on page 769

SENSe3:FREQuency:LIMLower:VALue on page 770

SENSe3 = Frequency, phase or group delay measurement

SENSe3:PHASe:LIMLower on page 773

SENSe3:PHASe:LIMLower:VALue on page 773

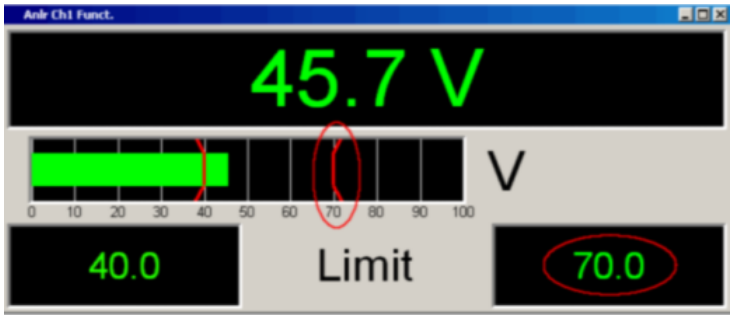
SENSe3 = Frequency, phase or group delay measurement

Limit Upper

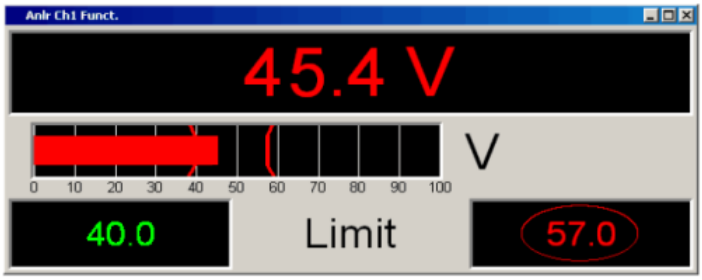
Used to activate/deactivate the upper limit check.

"activated" The upper limit check is activated.
The parameter field below is used to enter an upper limit in the units selected in the parameter field.

An upper limit can be defined for the measurement result; every measured value is then compared with this limit.
If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.
The upper limit is displayed as a value (bottom right) and as a red limit marker in the bar graph.



As soon as a limit is overranged, the measurement result and bar graph change from green to red; if the limit violation no longer exists, the measurement result and bar graph are displayed in green again.
A red measured value in the numeric display also indicates a limit violation:
In order to monitor limit violations over a long period of time without having to watch the measurement result display continuously, the upper limit is displayed permanently in red as soon as the limit is overranged after the START key has been pressed.



START key or re-entering the limit resets the hold function.
This hold function is not visible in the numeric display.

"deactivated" The upper limit check is deactivated.

Remote command:

SENSe<n1>:LIMUpper<n2> on page 772

SENSe<n1>:LIMUpper<n2>:VALue on page 772

SENSe<n1>: <n1> = 1| 2 | 6 (function measurements | Input Monitor | Level Monitor) ; LIMLower<ch>: <ch>= 1 | 2 (2 for two-channel instruments only)

SENSe3:FREQuency:LIMUpper on page 770

SENSe3:FREQuency:LIMUpper:VALue on page 770

SENSe3 = Frequency, phase or group delay measurement

SENSe3:PHASe:LIMUpper on page 773

SENSe3:PHASe:LIMUpper:VALue on page 773

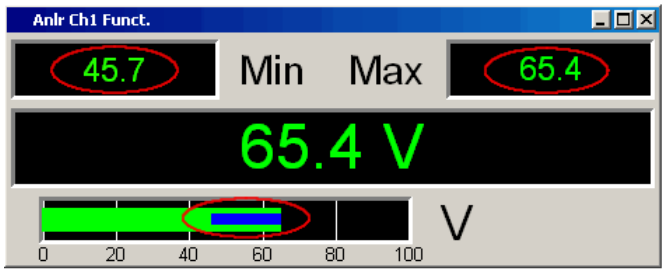
SENSe3 = Frequency, phase or group delay measurement

Show Min Max

Used to activate/deactivate the Min/Max display.

Two numeric values and the ends of the blue bar inside the green bar indicate the lowest and highest values measured.

"activated" The lowest and highest value measured since the START key was pressed are displayed.
The Min/Max values are shown in the top left and right-hand corners of the combo display.



The ends of the blue Min/Max bar indicate the lowest and highest values measured since the START key was pressed.
START key resets Min/Max value recording and the collection of measured values begins again.

"deactivated" The Min/Max display is deactivated.

5.46.4 Softkey Menu

Two-channel instruments:

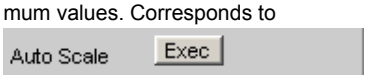
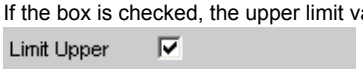
Every combo display has its own softkey menu. The settings selected in the menu apply exclusively to the associated combo display and affect no other combo display.

Multichannel instruments:

If a softkey menu from a combo display of a specific measurement function (e.g. Level Monitor) was used, the chosen setting affects **all** open combo displays for this mea-

surement function. In the case of multichannel instruments, there are no customized settings for individual channels.

The settings for "Store Reference", "Show Min/Max", "Show Lim Low" and "Show Lim Upp" can therefore be immediately displayed 1 to 1 in the associated measurement result configuration panel .

"Store Reference "	The current measured value is stored as a reference value. If, for example, the reference unit dBr is selected as the unit, the next measured value is 0.0 dBr.
"Autoscale "	One-time scaling of the bar graph on the basis of the minimum and maximum values. Corresponds to  in the associated configuration panel.
"Show Min Max "	If the box is checked, the min/max values are displayed. Corresponds to in the associated configuration panel.
"Show Lim Low "	If the box is checked, the lower limit value is displayed. Corresponds to in the associated configuration panel.
"Show Lim Upp "	If the box is checked, the upper limit value is displayed. Corresponds to  in the associated configuration panel.
"Restart Min/Max "	Resets min/max value recording in order to restart measurement. Corresponds to START
"Restart Lim Violation "	Resets the red color marking (measured value, bar and limit value) for indicating a limit violation and restarts a test for a limit violation.
"Config "	Opens the configuration panel for this combo display.

5.47 Limit Monitoring

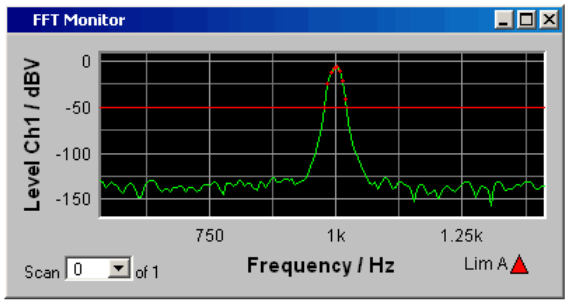
Both traces/bar graphs and measurement results can be monitored to determine whether limits or limit curves have been overranged or underranged.

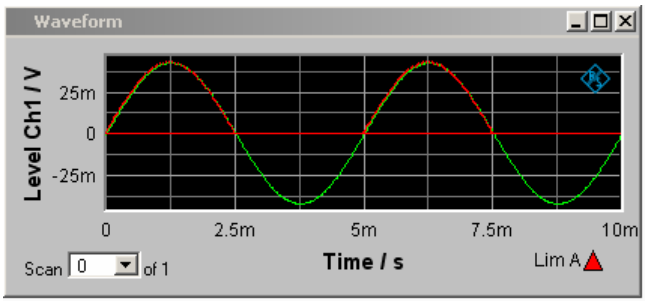
5.47.1 Traces and Bar Graphs

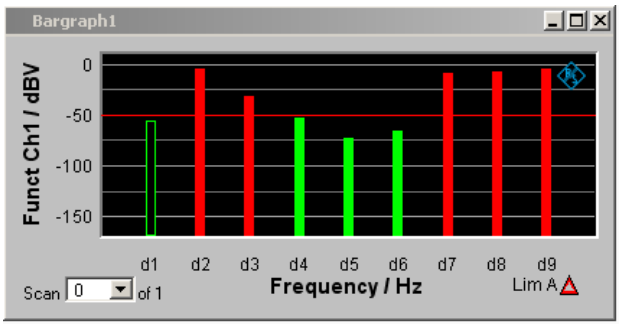
Upper and lower limits or a limit curve can be entered separately for Trace A and Trace B in every display configuration panel for every graphic subsystem.

Limit entered as a value:

The limit in a graphical display is shown as a straight line.

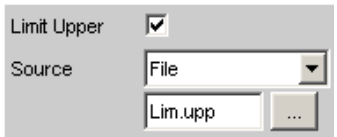


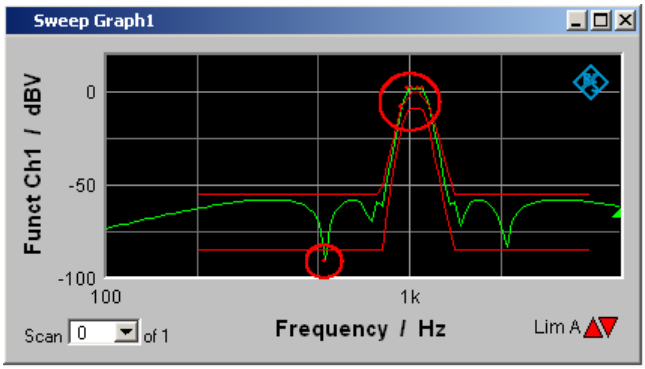


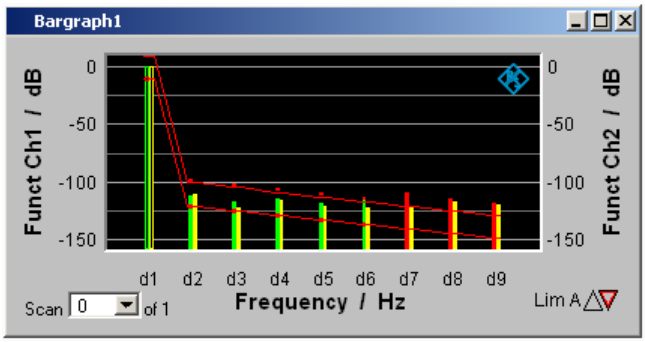


Limit entered as a curve:

A limit curve can be entered only for the graphic systems Sweep, FFT Function and Bar Graph. A limit curve makes no sense for the Waveform graphic system and is not offered.



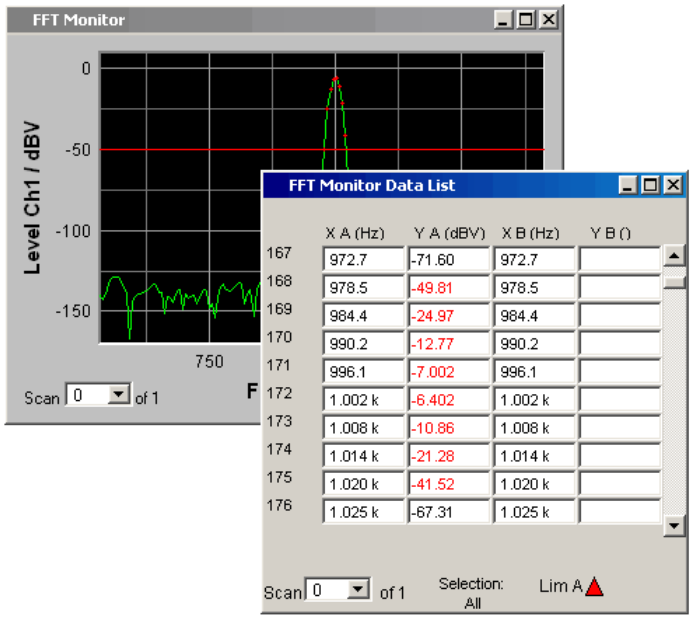




Each measured value is compared with the limit value or the limit curve and in the event of a limit violation is identified as a red dot in the trace display or as a red bar in the bar graph.

If multi-scan recording is performed in the Sweep Graph 1…4 graphic subsystems, all of the scans of a trace are checked against the associated limit or limit curve.

In the list of measured values, rows with measured values out of the tolerance are displayed in red (see chapter 5.44, "Result List", on page 545).



In addition to the red dots in the trace or the red bars in the bar graph, in the lower right corner of the graphic display and the measured value list there is an indicator of limit violations, so that it is possible to see at a glance whether any limit violation exists. The interpretation is as follows:

Display for limit violations

"Limit Upper" △

Limit Upper is activated and there is no limit violation.

"Limit Lower" ▽

Limit Lower is activated and there is no limit violation.

"Limit Upper past" △

The "Limit Upper" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Lower past" ▽

The "Limit Lower" value has been violated in the past but there is currently no limit violation. The violation is indicated until the START key is pressed again.

"Limit Upper current" ▲

The "Limit Upper" value is currently being violated.

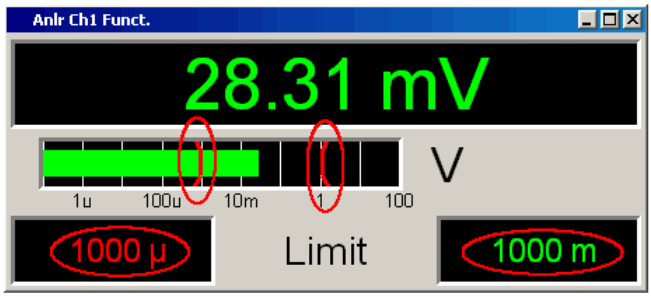
"Limit Lower current" ▼

The "Limit Lower" value is currently being violated.

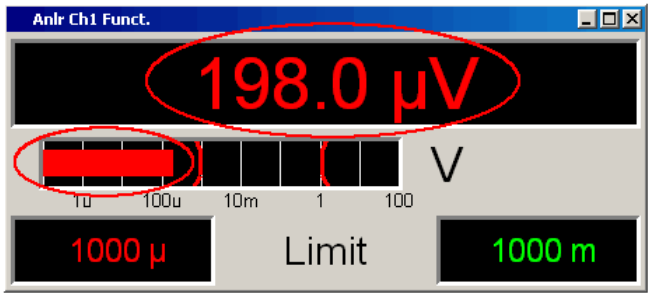
5.47.2 Measurement Results

A lower and upper limit can be specified in any measurement result configuration panel:

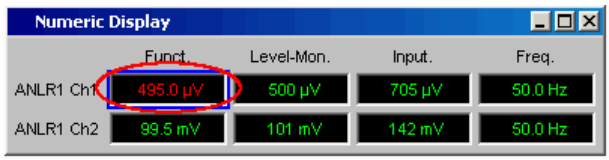
In the combo display, the limits are displayed as red limit markers (brackets) in the bar graph and as numeric values:



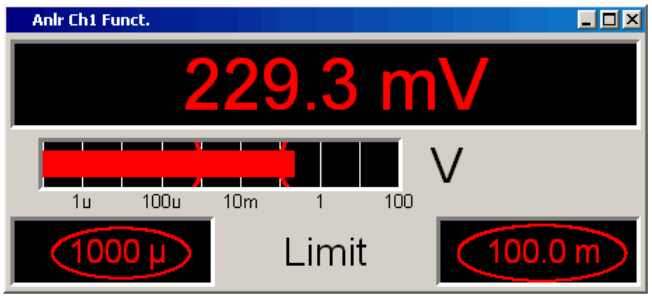
A red measured value and bar indicate that there is a limit violation:



A red measured value in the numeric display also indicates a **current** limit violation:



In order to indicate that the lower or upper limit was violated in the past, the lower or upper limit is displayed in red until the START key is pressed, which resets the hold function and restarts monitoring of the measured values:



This hold function is **not** visible in the numeric display.

5.48 Measured value Sequences

Measured value sequences consisting of acquired function measurement results, sweeps, FFT data, Waveform data, or Bar Graph data can be stored in a file for different purposes:

- To load the measured values again as a report, to permit comparison or to allow processing at a later stage. When loaded using commands in the display panel, the series of measured values are initially displayed exactly as they were when saved. They can, however, be rescaled or, for example, converted into different units.
- The files are stored in ASCII format so that they can be easily imported into other programs where the data can be processed further (e.g. Microsoft Excel). See section chapter 5.51, "Format", on page 589 for information on the ASCII format and how data can be imported into other programs.

5.49 Store

5.49.1 Trace Files

When a **Trace list** is saved no distinction is made between Trace A or Trace B.

Both traces are always stored to the file, provided that both traces are switched on. In the multiscan mode, all scans selected by means of the "History" line are stored to the file. If "Show Min Max " is enabled, these scans are stored too.

In addition to measured value sequences, a further range of information is stored necessary so that upon loading the trace list the graph is displayed just as when it was saved:

- Functionality on the x and y-axes
- Axis labeling
- Display units on the axes
- Scaling on the axes (lin/log)
- Left/right and top/bottom values of the axis scaling
- Limit values for the y-axes
- Reference values on the axes

When the trace file is loaded, this information affects the corresponding DispConfig panel so that the parameter fields reproduce the information stored in the file.

Exception: Exception: If "Hold " is set in the parameter fields "Reference ", "Limit Upper " and/or "Limit Lower " the current settings are not overwritten.

The format in which the trace list is stored is the same for all subsystems.

If the file name is specified without an extension, the suggested file name extension is `.TRC`, but any desired extension can be specified.

For a detailed description of the storage format, see section chapter 5.51.1, "Trace Files", on page 589.

5.49.2 Equalization Files

An **equalization list** is a table that contains frequency points and associated gain factors. The list can be used to apply a predefined frequency response to the generator. The set amplitude of the generator is changed as a function of frequency in accordance with the values specified in the table . Frequency values are stored to the list in the basic unit of Hz, irrespective of the unit used for x-axis value display.

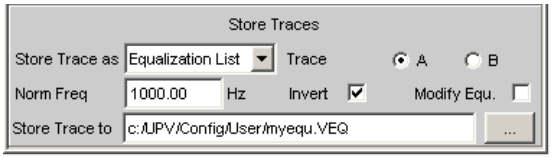
An equalization list in ASCII format is generated from the current measured value sequence, taking into account the settings made under "Trace ", "Norm Freq ", "Invert " and "Modify Equ. ". The list is stored to a file, which can be loaded by selecting it in the "Equalizer" line in the Generator Function panel.

An equalization file may contain up to 1024 X/Y pairs, because a generator sweep can have a maximum of 1024 sweep points. If a measured value sequence contains more than 1024 X/Y pairs, data will be compressed automatically such that only every 2nd, 4th, 8th X/Y pair and so forth is stored to the equalization file.

If an equalization list is generated from a multiscan display (including also the Min/Max scans of a single-scan display), the Y values of the currently selected scan are taken to generate the list.

If the file name is specified without an extension, the suggested file name extension is .VEQ, but any desired extension can be specified.

For a detailed description of the storage format, see section chapter 5.51.2, "Equalization Files", on page 593.



5.49.3 Sweep Lists

A **Sweep List** contains any desired sweep axis. Since the individual values of X are extracted from a current measured value sequence, they are in ascending order. If the file is then manually processed, the **separations** of the sweep points can be freely selected in order to place a greater number at places of particular interest without drastically increasing the total number of sweep points. The sweep points must, however, be specified in ascending or descending order – they must not change direction. The sweep points are processed by the sweep system in the order in which they are listed. There must be at least two different points in the list.

The file can contain a maximum of 1024 X values, because a generator sweep can have a maximum of only 1024 sweep points. If a measured value sequence has more than 1024 X/Y pairs, the data is compressed automatically by saving only every 2nd, 4th, 8th, etc. value for the sweep list.

If a sweep list is saved from a multiscan display (including the Min/Max scans in the case of a single scan display), the currently selected scan plays no role, since the X values are the same for all scans.

If the file name is specified without an extension, the suggested file name extension is .SPL, but any desired extension can be specified.

For a detailed description of the storage format, see section chapter 5.51.3, "Sweep Lists", on page 594.

5.49.4 Limit Files

A **Limit list** contains X and Y data that has been extracted from the current measured value sequence. When it is saved, no distinction is made about whether the file will be used later as an Upper Limit or as a Lower Limit. This depends on whether the file is **loaded** as an Upper Limit file or as a Lower Limit file. A limit list that has been obtained from a measured value sequence usually has more interpolation points than necessary, and it is therefore often necessary to process the file further. For information on how to do this see section chapter 5.52, "Editing", on page 597.

A limit list must contain at least two different points forming a straight line.

If a limit list is saved from a multiscan display (including the Min/Max scans in the case of a single scan display), the Y values are extracted from the currently selected scan.

The file can contain a maximum of 1024 X/Y pairs.

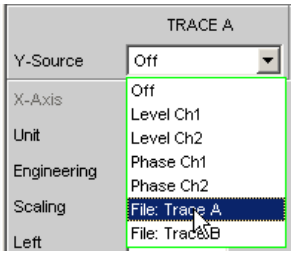
If the file name is specified without an extension, the suggested file name extension is .LIM, but any desired extension can be specified.

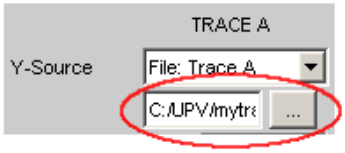
For a detailed description of the storage format, see section chapter 5.51.4, "Limit Files", on page 595.

5.50 Load

5.50.1 Trace Files

When **traces** are loaded, unlike when they are saved, a distinction is made between Trace A or Trace B. Since the trace file always contains both traces, provided both traces were enabled when saved, a decision is made via the parameter field "Y-Source " = File: Trace A or File: Trace B about which trace to load from the file.





All trace files have the file name extension *.TRC as a default setting, that is, if the file name only is specified, without an extension, this extension is automatically added. Other extensions are allowed. Clicking on the … button opens the file selector with all known properties.

During the loading procedure, the system tests whether the trace file can be loaded. When trace files are stored an identifier is entered so that it is obvious from which graphic system the file was saved. Trace files can only be loaded into the graphic system from which they were saved; in all other cases the attempt to load is ignored and an error message is issued. Exception: When Bar Graph trace files are being loaded, the system recognizes from the number of stored lines whether the file matches the set measurement function. For example, a Bar Graph trace file with 9 frequency lines in a bar graph display would be rejected for the measurement function DFD, because only 5 lines are expected there.

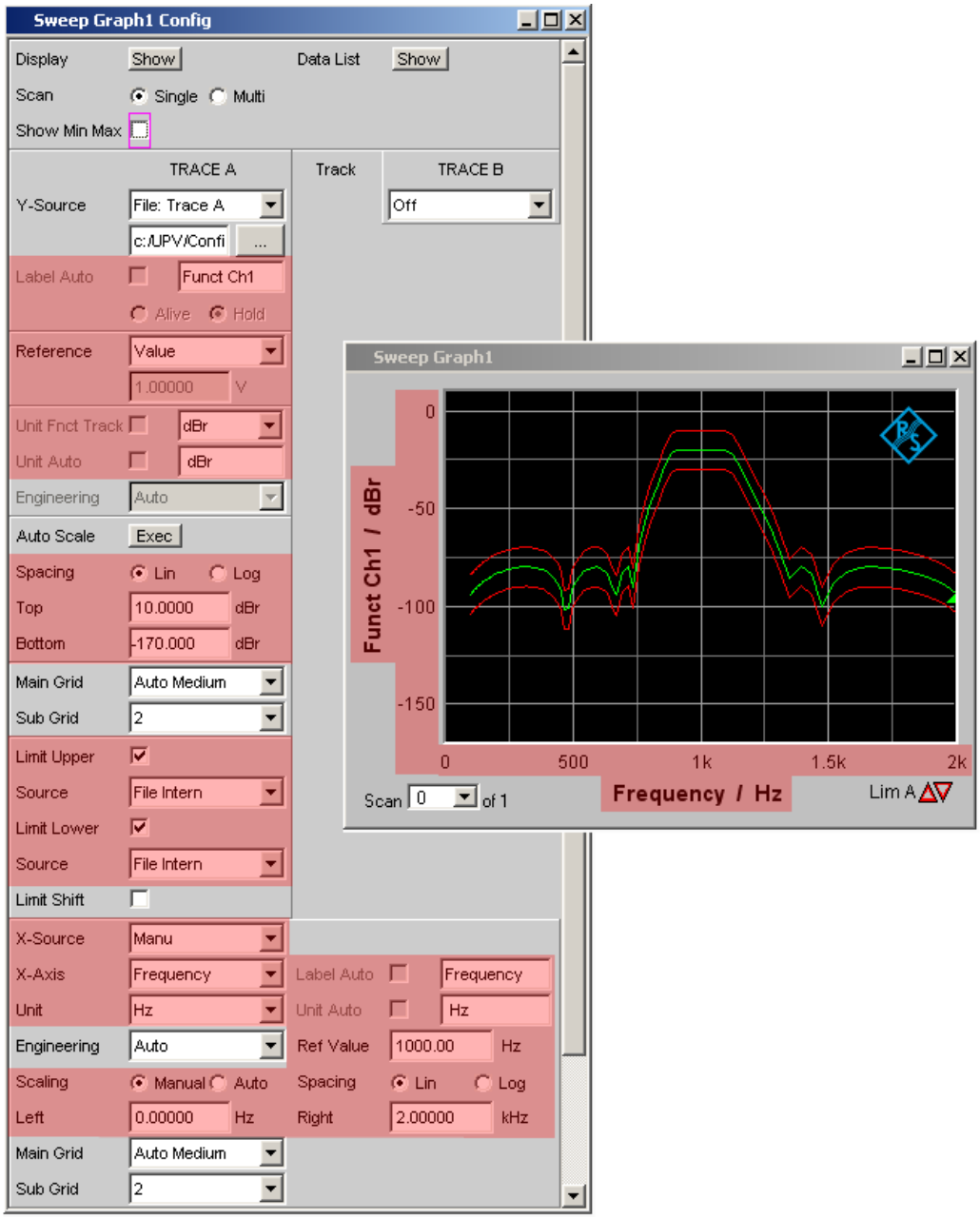
However, if there is ever a need to load a trace file of a different type into a graphic system, acceptance of the file can be forced through by changing the trace file identifier in an ASCII editor; see section chapter 5.52, "Editing", on page 597.

If a trace file cannot be loaded, or if "Y-Source " = File: Trace A or File: Trace B addresses a trace file in which the required trace does not exist, an appropriate warning is issued and the loading procedure is terminated. The previous trace in the graphical display remains unchanged.

The content of the trace files defines the appearance of the DispConfig panel and the associated display panel.

The appropriate scan is loaded from the trace file, depending whether "Scan " = Single or Multi in the parameter field and whether "Show Min Max " is set.

The following figure shows the parameter fields and wordings which are influenced by the file content.



If the file contains both reference traces and limit traces, **File Intern** is displayed in the corresponding parameter fields. "File Intern" means that there is no individual value (for example in the case of a "Reference", this would be "Limit Upper" or "Limit Lower" with the setting Value) but instead a trace, and that this trace has been taken from a file loaded at Y-Source = File: Trace A or File: Trace B.

Furthermore, all Auto and Tracking checkboxes such as Label Auto, Unit Func Track, Unit Auto etc. are deactivated and grayed out so that they cannot be used. All parameter fields that allow Auto settings, such as "X-Source " or "Scaling ", are set to "Manual", since they are preset by the file content.

If Hold is selected in the parameter fields "Reference", "Limit Upper " and/or "Limit Lower ", the **current settings** remain unchanged and are **not altered** by loading a trace file.

Switching the Y-Source:

The display and deletion of traces largely depends on switching the "Y-Source", that is, the source of the traces.

The "Y-Source" parameter field offers two sources for the recording and display of traces:

- **Traces from measurements** are all settings other than "File: Trace A" or "File: Trace B", e.g. Funct CH1, Level Ch1, Phase Ch1 etc.
- **Traces** can be loaded **from File** with File: Trace A or File: Trace B.
- **Off** deletes the trace.

Deleting traces:

Traces are generally always deleted either by using the START key or by switching the "Y-Source " to Off.

When the "Y-Source " is switched between measurement (e.g. "Funct Ch1") and file (e.g. File: Trace A), a trace is always deleted when the basic unit changes.

5.50.1.1 Switching measurements in multiscan mode:

The reaction of the R&S UPP depends largely on whether or not the basic unit changes.

Example:

Basic unit does not change:

The RMS measurement function is set in the analyzer. The selected display unit is dBV. Funct CH1 is set in the Sweep Graph Config panel as the "Y-Source" which means that the results of the RMS measurement are displayed on the y-axis. Also in the analyzer the Level Monitor is set with the measurement function "Peak" and the display unit "dBu".

If the "Y-Source" is switched in the Sweep Graph Config Panel from Funct CH1 to LevelMon Peak Ch1, the basic unit does not change; in both cases, Volt is the basic unit of dBV and dBu!

The current scan is retained.

If the switch takes place during a measurement, the new scan is linked to the old scan already drawn. If the measurement was halted, the new scan is drawn after the SINGLE BUTTON IS PRESSED

The scans in the other channel are unaffected.

Example:

Basic unit changes:

The RMS measurement function is set in the analyzer. The selected display unit is dBV. "Funct CH1" is set in the Sweep Graph Config panel as the "Y-Source", which means that the results of the RMS measurement are displayed on the y-axis. Also in the analyzer the phase measurement is set with the display unit Rad.

If the "Y-Source" is now switched in the Sweep Graph Config panel from "Funct CH1" to Phase, the basic unit changes, since the basic unit of dBV is Volt and the basic unit of Rad is °.

The current scans are deleted.

If the switch takes place during a measurement, the new scan is redrawn in the cleared graphic window. If the measurement was halted, the new scan is drawn after the SINGLE button is pressed.

The scans in the other channel are unaffected.

5.50.1.2 The last file that was loaded determines the x-axis

If files with different x-axes are loaded one after the other, the last file always determines the x-axis. If a sweep with a different x-axis is then loaded, it will determine the x-axis.

5.50.1.3 Loading a trace file with measurement in progress or halted

On switching from a measurement to loading a trace from a file (e.g. "Y-Source " from "Funct CH1" to File: Trace A), deletion takes place and the trace from the file is displayed immediately, provided the basic unit is permitted in the current graphic subsystem and the basic unit is suitable for the x-axis. The panel content changes according to the parameters stored in the trace file, as described above.

Any attempt to load a trace file containing the results of a phase measurement into the Waveform graphic system would be ignored with an appropriate warning, since a phase measurement result is not provided for in the Waveform graphic system. The current trace would be retained.

5.50.1.4 Switching from a loaded trace file to measurement:

On switching from a trace loaded from file to measurement (e.g. "Y-Source " from File: Trace A to FFT Level Ch1), the current scan is retained, provided the basic unit is suitable. The new scan is drawn when the SINGLE button is pressed. This reaction is particularly important, since in this way new measured value scans can be appended to the scans loaded from a file! If the basic unit is not suitable, the current scans are deleted.

5.50.1.5 Loading trace files, depending on the single scan or multiscan setting:

Depending whether "Scan " = Single or "Scan " = Multi the appearance changes when loading or recording scans.

"Scan " = Multi

If a trace is loaded from a file which contains a multiscan, either all scans are taken from the file or only as many as the number specified in the "History" parameter field. If the file contains only a single scan, this scan is interpreted as a multiscan with only one scan. If "Show Min Max "is checked and Min/Max scans are stored in the trace file, these are also loaded.

"Scan " = Single

If a scan is loaded from a file which contains a multiscan, the first scan is loaded from it. If "Show Min Max "is checked and Min/Max scans are stored in the trace file, these are also loaded. A single scan is then displayed with a maximum of three scans per channel.

If "Y-Source" is switched to File: Trace A or File: Trace B, the "Alive / Hold " parameter field is shown as not user-accessible and has the setting "Hold " since an Alive/Hold option makes no sense for a trace loaded from file.

If "Y-Source" is switched to measurement, the "Alive / Hold " parameter field is again accessible and has the setting "Alive".

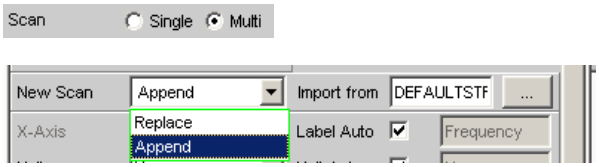
On switching from "Scan " = Single to "Scan " = Multi the single scan is retained and "New Scan " is forced to the Append mode. New scans are added each time the SINGLE button is pressed.

On switching from "Scan " = Multi to Scan = the last scan of the current multiscan is retained.

5.50.1.6 Appending or substituting scans

The parameter field "New Scan" = Append or Replace defines whether scans are appended to existing scans or whether a single scan replaces another.

The parameter fields "New Scan " and "Import from " are offered only for multiscan ("Scan" = "Multi"), since new scans can be appended or substituted only in multiscan recording.



The scans to be appended or substituted may come from a measurement or a file. By far the most frequently used setting is "New Scan " = Append.

There are a number of options for appending or substituting scans. These options depend on the following settings and conditions:

- "Alive / Hold "
- Append or substitute measurement scan
- Append or substitute scan from file
- Is a measurement in progress or halted?
- Which scans and how many scans are stored in a file?

- Does the scan from the file suit the current setting?

The following section should cover the most important possibilities.

5.50.1.7 Appending Measurement Scans to Existing Scans

parameter field "New Scan " = Append

parameter field "Alive / Hold " to Alive.

SINGLE triggers a measurement and appends the new scan to the existing scans.

5.50.1.8 Measurement Scan Replaces an Existing Scan

parameter field "New Scan " = Replace

parameter field "Alive / Hold " to Alive.

Use the NEXT SCAN key to select the scan to be replaced.

SINGLE triggers a measurement and replaces the selected scan with the new scan.

5.50.1.9 Importing Scans from a File and Appending to Existing Scans

parameter field "New Scan " = Append

Parameter field "Alive/Hold" to Hold.

If the parameter field "Alive/Hold" is on "Alive" and a measurement is in progress (single measurement not yet finished or continuous measurement), any attempt to import a file is ignored and a message is issued.

If the parameter field "Alive / Hold " is on "Alive" and a measurement is finished, a scan / multiple scans can be imported from a file and appended to the existing scans.

If an import is allowed, it largely depends on the content of the source file to be imported whether and how the operation proceeds.

A file will be imported only if the basic units from the file match the "Y-Source" setting, or if the unit is allowed in the graphic subsystem. For example if "Y-Source " = Funct Ch1 and the set analyzer measurement function = "RMS", a trace file with the basic unit Volt is suitable. A trace file with the basic unit % would be ignored and an error message would be issued.

When loading a trace file it must be clearly specified which trace is to be loaded from the file (File: Trace A or File: Trace B).

This choice is not needed when importing. Provided the basic units are suitable for the current setting, the file content defines what and how much will be imported:

- If only Trace A or only Trace B is activated in "Y-Source" and the file to be imported contains only one trace and it does not matter whether it is Trace A or Trace B, then this trace is imported.

- If Trace A and Trace B are both activated and the file to be imported contains only one trace, and it does not matter whether it is Trace A or Trace B, this trace is imported to Trace A **and** Trace B.
- If only Trace A or only Trace B is activated and the file to be imported contains a stereo trace, that is, Trace A and Trace B, the corresponding trace is imported, namely A to A or B to B.
- If Trace A and Trace B are both activated and the file to be imported contains a stereo trace, then both traces are imported, namely A to A and B to B.

The following applies to all the cases listed:

All suitable scans from the file are appended. Starting from the first scan, all scans are appended from the file until the maximum number of 20 scans is reached.

If "Hold" is selected in the parameter fields "Reference ", "Limit Upper " and "Limit Lower ", the current settings are not changed by the imported scan.

5.50.1.10 Importing Scans from a File and Replacing an Existing Scan

parameter field "New Scan " = Replace

Parameter field "Alive/Hold" to Hold.

If the parameter field Alive/Hold is on "Alive" and a measurement is in progress (single measurement not yet finished or continuous measurement), any attempt to import a file is ignored and a message is issued.

If the parameter field "Alive/Hold" is on "Alive" and a measurement is finished, a scan can be imported from a file and replace a scan.

If the default settings agree, it largely depends on the content of the import file whether and how the operation proceeds.

A file will be imported only if the basic units from the file match the "Y-Source" setting, or if the unit is allowed in the graphic subsystem. For example if "Y-Source " = Funct Ch1 and the set analyzer measurement function = "RMS", a trace file with the basic unit Volt is suitable. A trace file with the basic unit % would be ignored and an error message would be issued.

When loading a trace file it must be clearly specified which trace is to be loaded from the file (File: Trace A or File: Trace B).

This choice is not needed when importing. Provided the basic units are suitable for the current setting, the file content defines what and how much will be imported:

- If only Trace A or only Trace B is activated in "Y-Source" and the file to be imported contains only one trace and it does not matter whether it is Trace A or Trace B, then this trace is imported.
- If Trace A and Trace B are both activated and the file to be imported contains only one trace, and it does not matter whether it is Trace A or Trace B, this trace is imported to Trace A **and** Trace B.
- If only Trace A or only Trace B is activated and the file to be imported contains a stereo trace, that is, Trace A and Trace B, the corresponding trace is imported, namely A to A or B to B.

- If Trace A and Trace B are both activated and the file to be imported contains a stereo trace, then both traces are imported, namely A to A and B to B.

The following applies to all the cases listed:

If the file contains more than one scan a warning is given and the **first scan** from the file is taken for the Replace function.

If "Hold" is selected in the parameter fields "Reference ", "Limit Upper " and "Limit Lower " the current settings are **not changed** by the imported scan. .

5.50.2 Equalization Files

The loading of equalization files takes place in the generator; see section chapter 5.6, "Generator Signals", on page 221.

Equalization files from the R&S UPL can still be used.

5.50.3 Sweep Lists

The loading of sweep lists takes place in the generator; see section on page chapter 5.6, "Generator Signals", on page 221.

Sweep lists from the R&S UPL can still be used.

Sweep lists from the R&S UPL have different file name extensions:

- SPF for frequency values in Hz
- SPV for level values in V or FS
- SPO for on-time values in s
- SPI for interval values in s
- DWL for dwell time values in s

From these file name extensions the R&S UPP recognizes whether the loading procedure is allowed. It is therefore recommended that the file name extensions of the old R&S UPL files should not be changed!

5.50.4 Limit Files

The loading of **limit files** takes place in the DispConfig panels in the parameter fields "Limit Upper ", "Source " = File and "Limit Lower ", "Source " = File.

The Y values of the limit files are always interpolated onto the current x-axis, so that the desired trace is always produced regardless of the number of interpolation points in the limit file. Limit files from the R&S UPL can also be used but, in contrast to limit files from the R&S UPP , there is no plausibility check as to whether the numerical values in the file match the current setting, since R&S UPL files do not contain the associated units.

5.51 Format

5.51.1 Trace Files

All trace data is stored in plain text in ASCII format . The format has been selected so that the data can be processed without a problem in EXCEL.

Structure of the trace file:

Subsystem: UPV FFT TRACE FILE									
Title: Titletext									
Comment: Commenttext									
X Axis;	**Trace A;**				**Trace B;**				
X Function Frequency	Trace A Function Funct Ch1				Trace B Function Funct Ch2				
X-Axis-Label: Frequency	Y1-Axis-Label: Input RMS analog Ch1				Y2-Axis-Label: THD+N digital CH2				
X-Unit: Hz	A-Unit: dBV				B-Unit: dB				
X-Spacing: LOG	A-Spacing: LIN				B-Spacing: LIN				
X-Left: Value	A-Bottom: Value				B-Bottom: Value				
X-Right: Value	A-Top: Value				B-Top: Value				
VOID	A-LimLow: Value, FILE or VOID				B-LimLow: Value, FILE or VOID				
VOID	A-LimUpp: Value, FILE or VOID				B-LimUpp: Value, FILE or VOID				
Scan #1	A-Comment: Scan Labeltext				B-Comment: Scan Labeltext				
X-Basic-Unit: Hz	A-Basic-Unit: V				B-Basic-Unit: V				
X-Ref: Value	A-Ref: Value, FILE or VOID				B-Ref: Value, FILE or VOID				
A-X/ datacount	**A-Y**	**A-LimLow**	**A-LimUpp**	**A-RefY in V**	**B-X/ datacount**	**B-Y**	**B-LimLow**	**B-LimUpp**	**B-RefY in V**
20.0000	0.201	0.2	0.3	1.01	20.0000	-98.8	-98.5	-90	VOID
..			..	..			..	..	
20000.0	0.203	0.25	0.4	2.03		-98.1	-98.5	-90	VOID
Scan #2	A-Comment: Scan Labeltext				B-Comment: Scan Labeltext				
X-Ref: Value	A-Ref: Value or VOID				B-Ref: Value or VOID				
X/datacount	**A-Y**	**A-LimLow**	**A-LimUpp**	**A-RefY in V**	**B-X/ datacount**	**B-Y**	**B-LimLow**	**B-LimUpp**	**B-RefY in V**
20.0000	0.201	0.2	0.3	1.01	20.0000	-98.8	-98.5	-90	VOID
..			..	..			..	..	
20000.0	0.203	0.25	0.4	2.03		-98.1	-98.5	-90	VOID

The individual parameters are TAB separated.

Black: Explanation of fields. These explanations are not stored in the trace file.

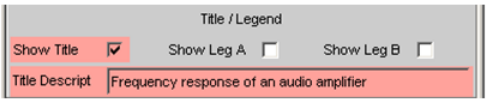
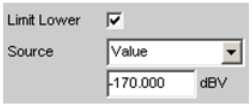
Green: Fixed entries in ASCII format to facilitate assignment of the following data.

Red: Entries which change. These entries are depending on the graphic system and the settings in the corresponding DispConfig panel.

FILE: Not a fixed value, but a trace. Can occur in the case of Limit and Reference.

VOID: No value present because the trace is turned off, or in order to fill a missing range in the event that Trace A and Trace B have different lengths.

Explanation of terms:

Subsystemkennung			Kennung von welchem Grafik-Subsystem aus diese Trace-Datei angelegt wurde, z.B. UPV SWEEPLIST FILE UPV SWEEP TRACE FILE UPV FFT TRACE FILE UPV WAVEFORM TRACE FILE UPV BARGRAPH TRACE FILE
Title			Eintrag aus dem Grafik-Panel 
Comment			Gerätebezeichnung, Seriennummer, Datum und Uhrzeit wann dieses Trace-File abgespeichert wurde, z.B. "R&S UPP800 Serial no: 123456, 2012-24-5, 12:3:21" Das Datum wird im internationalen Datumsformat (Y-M-D) ausgegeben.
X Axis	**Trace A**	**Trace B**	Feste Einträge in der Trace-Datei im ASCI-Format um die Zuordnung der folgenden Daten zu erleichtern.
X Function	Trace A Function	Trace B Function	Messfunktion, die auf der entsprechenden Achse eingestellt ist, z.B. Frequency Function Ch1 Function Ch2
X-Axis-Label	Y1-Axis-Label	Y2-Axis-Label	Beschriftung der X-Achse, der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B) z.B. Frequency/Hz Function Ch1/V Function Ch2/V
X-Unit	A-Unit	B-Unit	Einheit der X-Achse, der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B) der grafischen Darstellung z.B. Hz V V
X-Spacing	A-Spacing	B-Spacing	Lineare oder logarithmische Unterteilung der X-Achse, der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B), z.B LIN LOG LOG
X-Left	A-Bottom	B-Bottom	Linker Wert der X-Achse, unterer Wert der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B).
X-Right	A-Top	B-Top	Rechter Wert der X-Achse, oberer Wert der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B).
	A-LimLow	B-LimLow	Unterer Grenzwert der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B). Ist hier der Grenzwert VOID eingetragen, ist die Grenzwertüberprüfung ausgeschaltet. Ist hier ein Wert eingetragen, wird für die Grenzwert-prüfung der Wert aus dem Konfigurationspanel des Grafiksystems verwendet. Weiter unten im Datenbereich dieses Files erscheint zu jeder Datenzeile unter **A-LimLow** und **B-LimLow** dieser Wert.  Ist hier der Schriftzug FILE eingetragen, kommen die Grenzwerte von einer Grenzwert-Datei. Die auf die X-Achse interpolierten Grenzwerte sind weiter unten im Datenbereich dieses Files unter **A-LimLow** und **B-LimLow** aufgelistet.
	A-LimUpp	B-LimUpp	Dto. oberer Grenzwert der linken Y1-Achse (Trace A) und der rechten Y2-Achse (Trace B).

Scan #Nr	A-Comment	B-Comment	Scan #Nr: Scan number for the following data set, numbered sequentially 2, 1, 0, -1 to -19. Scan number 2 designates the maximum scan, scan number 1 the minimum scan, provided that is activated. Scan number 0 designates the most recent scan. The more negative the scan number, the older the scan. A-Comment and B-Comment are reserved for future R&S UPV program versions.
X-Basic-Unit	A-Basic-Unit	B-Basic-Unit	**Basic unit** of the X axis, the left Y axis (Trace A), and the right Y axis (Trace B) in the graphical display. If the following reference values are present, (that is != VOID), these units are identical to the basic unit of the following reference values.
X-Ref	A-Ref	B-Ref	Reference values for referenced units of the X axis, the left Y axis (Trace A), and the right Y axis (Trace B) **in the basic unit**. The value entered here is taken into the configuration panel of the graphic system as a fixed reference value when the trace file is loaded: If the word **FILE** is entered for A-Ref and / or B-Ref, the reference values come from a reference file or it is a floating reference value. The reference values interpolated onto the X axis are listed under "A-RefY in *unit*" and "B-RefY in *unit*" of the scan data sets. **VOID** is used as a placeholder for the reference value of a scan which is turned off. Special case: If the intention is to display the result of an intermodulation measurement in % or dB on the Y axis in the Bargraph graphic system, then no further reference is possible for this unit since it is already referenced. The "Reference" parameter field is displayed as inaccessible. Since no X axis is offered there is no X reference value either. In such cases the value **3.402823466385e+038** is entered in the trace file instead of a reference value and stands for NaN (Not a Number).

A-X/*datacount* **A-Y** **A-LimLow** **A-LimUpp** **A-RefY in *unit*** **B-X/*datacount*** **B-Y** **B-LimLow** **B-LimUpp** **B-RefY in *unit*** This wording is arranged horizontally in the trace file.	**A-X/*datacount***: Datacount identifies the number of following data sets (lines) for this scan. The number of data sets for Trace A can be different to the number for Trace B. **A-X**: X value in the unit specified at X Unit. **A-Y**: Y value of Trace A in the unit specified at A Unit. **A-LimLow**: Lower limit of Trace A from a limit file in the unit specified at A Unit. If VOID is entered here, there are no limit values from a file. **A-LimUpp**: Likewise upper limit. **A-RefY in *unit***: Unit of the reference values of Trace A interpolated onto the X axis from a reference file, e.g. dBV. Caution: The reference values themselves are stored in the basic unit, e.g. V. **A-RefY**: Reference values of Trace A in the basic unit. **B-X/*datacount***: Datacount identifies the number of following data sets (lines) for this scan. The number of data sets for Trace A can be different to the number for Trace B. **B-Y**: Y value of Trace B i in the unit specified at B Unit. **B-LimLow**: Lower limit of Trace B from a limit file in the unit specified at B Unit. If VOID is entered here, there are no limit values from a file. **B-LimUpp**: Likewise upper limit. **B-RefY in *unit***: Unit of the reference values of Trace B interpolated onto the X axis from a reference file, e.g. dBV. Caution: The reference values themselves are stored in the basic unit, e.g. V. **B-RefY**: Reference values of Trace B in the basic unit.

Example of a trace data set:

The trace data set was generated from the FFT Graph subsystem.

```
UPV FFT TRACE FILE
Heading String
R&S UPP800 Serial no: 123456, 2012/24/5, 9:51:42
X Axis Trace A Trace B
Frequency FFT Level Ch1 FFT Level Ch2
Frequency / Hz FFT Level Ch1 / dBV FFT Level Ch2 / V
Hz dBV V
LIN LIN LIN
0 -170 0
22000 10 1
VOID VOID VOID
VOID VOID VOID
Scan #0 Labeltext Labeltext
Hz V V
1000 1.00e+000 1.00e+000
A-X/256 A-Y A-LimLow A-LimUpp A-RefY in dBV B-X/256 B-Y B-LimLow B-LimUpp BRefY
in dBV
0.00e+000 -1.08e+002 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
9.37e+001 -9.93e+001 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
```

```
1.87e+002 -1.01e+002 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
::
2.37e+004 -1.36e+002 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
2.38e+004 -1.37e+002 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
2.39e+004 -1.34e+002 VOID VOID 1.00e+000 VOID VOID VOID VOID VOID
```

The individual parameters are stored in the original with a considerably greater number of points. Due to the restricted page width the data set for this display has been reduced in size.

If a data set is subsequently edited manually, comment lines can be inserted at any position **ahead of** the frequency values. Comment lines must **begin with the character '#'** .

A data set must never be interrupted by comments!

5.51.2 Equalization Files

The equalization data is stored in plain text in ASCII format. The format has been selected so that the data can be processed without a problem in EXCEL.

Structure of the equalization file:

Kennung: UPV EQUALIZATION FILE	
Anzahl der folgenden X/Y-Pärchen: 100 # Datacount	
Inverted oder Not inverted: # Inverted	
Normfrequenz: # 1000.000000 Hz # Norm frequency	
Normierungswert: # 0.100177 V # Norm value	
100.000000000000	4891.695800781250
103.072242736816	4622.376953125000
106.238868713379	4368.537597656250
:	:
1027.808593750000	1.006141066551
:	:
2000.000000000000	4583.853027343750

The individual parameters are TAB separated.

Black: Explanation of fields. These explanations are not stored in the equalization file.

Green: Fixed entries in ASCII format.

Red: Entries which change depending on the settings in the corresponding DispConfig panel.

Table 5-5: Explanation of terms:

Identifier	Identifies the file as an equalization file. During loading this identification is used to decide whether the file concerned can be loaded.
Number of following X/Y pairs	Self-explanatory
Inverted or Not inverted	A comment which states whether the equalization factors have been stored inverted or not inverted. The effect of inverting the frequency response in the generator by means of an equalization file created with the "Invert" setting is that the same DUT - with the precorrector enabled - now receives an undistorted frequency response.

Norm frequency	A comment which states the frequency whose voltage value has been used for normalization.
Normalization value	A comment which states the normalization value with which the Y values were computed as factors.
X/Y pairs	Frequency value in Hz followed by the normalization factor. If the frequency selected on saving the equalization file was that at which the frequency response curve is at its maximum, the precorrector file contains only values from 0.0 to 1.0. If a different frequency is selected, factors greater than 1.0 also occur.

Example of an equalization data set:

```
UPV EQUALIZATION FILE
100 # Datacount
# Inverted
# 1000.000000 Hz # Norm frequency
# 0.100177 V # Norm value
100.000000000000 4891.695800781250
103.072242736816 4622.376953125000
106.238868713379 4368.537597656250
 :
1027.808593750000 1.006141066551
 :
1940.386596679688 2496.481933593750
2000.000000000000 4583.853027343750
```

If a data set is subsequently edited manually, comment lines can be inserted at any position **ahead** of the X/Y pairs.**Comment lines** must begin with the character '#' .**A data set must never be interrupted by comments**!

5.51.3 Sweep Lists

The sweep list data is stored in plain text in ASCII format. The format has been selected so that the data can be processed without a problem in EXCEL.

Sweep points must be specified in ascending or descending order – they must not change direction, for example due to editing!

```
Kennung: UPV SWEEPLIST FILE
Anzahl der folgenden X-Werte: 9 # Datacount
Basiseinheit: Hz # Basic unit
16.000000000000
20.000000000000
25.000000000000
31.500000000000
40.000000000000
50.000000000000
63.000000000000
```

Black: Explanation of fields. These explanations are not stored in the sweep list.

Green: Fixed entries in ASCII format.

Red: Entries which change depending on the settings in the corresponding DispConfig panel.

Table 5-6: Explanation of terms:

Identifier	Identifies the file as a sweep list. During loading this identification is used to decide whether the file concerned can be loaded.
Number of following X values	Self-explanatory
Basic unit	The X values in the sweep list are always stored in the basic unit. If, for instance, the X values in the trace from which the sweep list was derived are in ΔHz, the basic unit is entered as Hz and the X values are recomputed and stored in Hz. Basic units can occur as Hz, V, FS, UI, s and DEG (°). The R&S UPP uses this entry to recognize whether the loading operation is allowed for this file with regard to the current setting. If, for example, an attempt was made to load a sweep list with the basic unit Hz for a voltage list sweep, such a file would be ignored.
X values	X values for a list sweep

Example of a sweep list data set:

```
UPV SWEEPLIST FILE
9 # Datacount
Hz # Basic unit
16.000000000000
20.000000000000
25.000000000000
31.500000000000
40.000000000000
50.000000000000
63.000000000000
80.000000000000
100.000000000000
```

If a data set is subsequently edited manually, comment lines can be inserted at any position **ahead of** the frequency values. Comment lines must **begin with the character '#'** .**A data set must never be interrupted by comments**!

5.51.4 Limit Files

The limit data is stored in plain text in ASCII format. The format has been selected so that the data can be processed without a problem in EXCEL.

Structure of the limit file:

Kennung: UPV LIMIT FILE	
Anzahl der folgenden X/Y-Pärchen: 9 # Datacount	
Offset ON/OFF: # Offset ON	
Offsetwert: # Offset value = 10 dBV	
X- und Y-Einheit: Hz dBV	
100	-70
711	-70
789	-45
875	-10
970	-10
1076	-10
1193	-30
1323	-70
2000	-70

Black: Explanation of fields. These explanations are not stored in the sweep list.

Green: Fixed entries in ASCII format.

Red: Entries which change depending on the settings in the corresponding DispConfig panel.

Table 5-7: Explanation of terms:

Identifier	Identifies the file as a limit file. During loading this identification is used to decide whether the file concerned can be loaded.
Number of following X/Y pairs	Self-explanatory
Offset ON/OFF	A comment which states whether, during the generation of a limit file from a measured value sequence, an offset value was added (ON) or not (OFF) to the Y data.
Offset value	A comment which states which offset value was added to the Y data during the generation of a limit file from a measured value sequence
X and Y unit	Depending on the selected x-axis and the measurement function, a very diverse range of units can be entered here for the X / Y values. Examples for the X values: Hz, °, s, V, FS or UI. Examples for the Y values: V, dBV, dBr, … V/Vr, °, s, db, % etc.
X/Y pairs	X/Y pairs in the specified units.

Example of a limit data set:

```
UPV LIMIT FILE
9 # Datacount
# Offset ON
# Offset value = 10.0 dBV
Hz dBV
100 -70
711 -70
789 -45
875 -10
970 -10
1076 -10
1193 -30
```

```
1323 -70
2000 -70
```

If a data set is subsequently edited manually, comment lines can be inserted at any position **ahead** of the X/Y pairs. Comment lines **must begin with the character '#'**. **A data set must never be interrupted by comments**

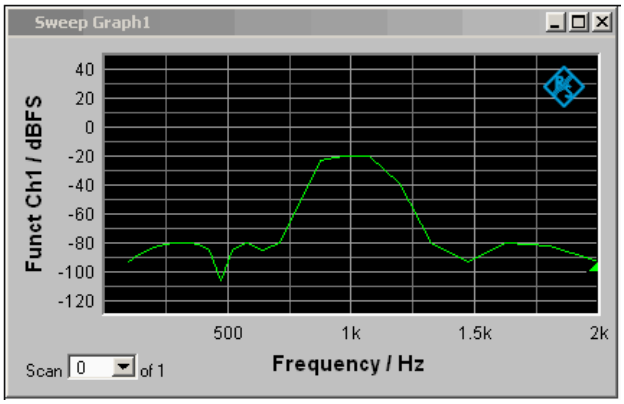
5.52 Editing

The editing of trace files, equalization files, sweep lists and limit files is always carried out in the same way and is illustrated by two examples. The procedure is not explained point by point in the examples – this would be beyond the scope of this description. The examples are really intended for the trained user.

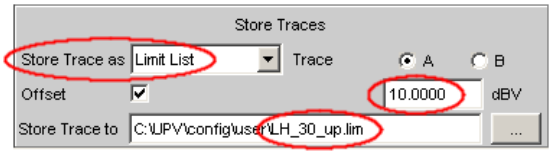
Example:

The intention is to generate a tolerance band from the frequency response of an ideal DUT. This tolerance band will be compared to the other DUTs.

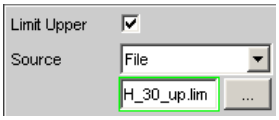
The measured value sequence of this ideal DUT is generated by means of a 30 point sweep.

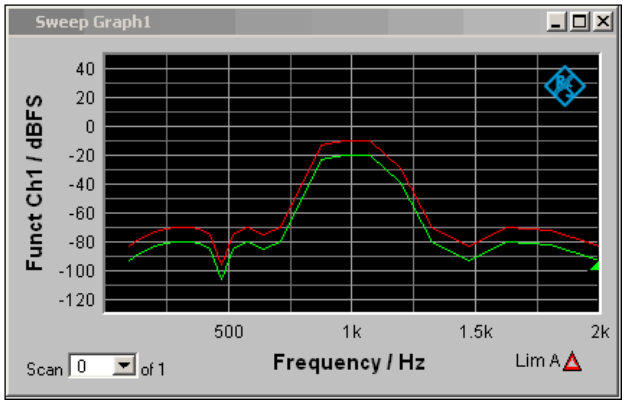


Using "Store Trace as " "Limit List", a limit file with 30 pairs of X/Y values is generated from this measured value sequence and stored as LH_30_up.lim. The Y values of the limit curve are provided with an additive offset of 10 dBV, producing a limit curve that is parallel shifted by 10 dBV compared to the measured value sequence.



If the limit curve is loaded as Limit Upper, the parallel shift can be seen to be upward.





However, the limit curve derived from a measured value sequence is unsuitable as the upper limit of a tolerance band, since horizontal lines should appear to left and right of the passband in the bandpass display. This makes it necessary to modify the limit file.

For this purpose, the file named `LH_30_up.lim` is loaded into an ASCII editor, such as the Windows Editor, which is present as an accessory on every Windows operating system for the R&S UPP. The editor displays a data set as shown in the left column above.

This data set is then modified as shown in the right column. The modified data record in the right column is stored in the file LH_9_up.lim.

LH_30_up.lim

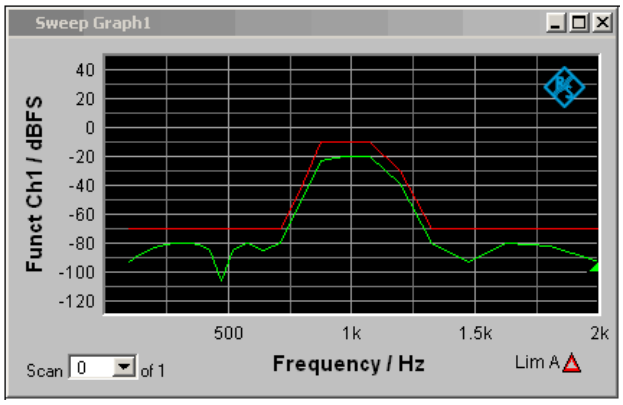
```
UPV LIMIT FILE
30 # Datacount
# Offset ON
# Offset value = 10.000000 dBV
Hz          dBV
100.000000000000        -83.702377319336
110.882522583008        -82.031776428223
122.949340820313        -80.389442443848
136.329330444336        -78.784820556641
151.165405273438        -77.228446960449
167.616012573242        -75.734764099121
185.856872558594        -74.320167541504
206.082794189453        -73.010757446289
228.509796142578        -71.841300964355
253.377426147461        -70.862701416016
280.951293945313        -70.152404785156
311.525878906250        -69.837203979492
345.427764892578        -70.144065856934
383.019012451172        -71.554283142090
424.701171875000        -75.466735839844
470.919372558594        -96.235939025879
522.167297363281        -75.033081054688
578.992248535156        -69.949821472168
642.001220703125        -75.313186645508
711.867187500000        -69.820259094238
789.336303710938        -44.014369964600
875.236022949219        -13.052226066589
970.483764648438        -9.946021080017
1076.096923828125       -9.984798431396
1193.203369140625       -28.528638839722
1323.054077148438       -70.569931030273
1467.035766601563       -82.768814086914
1626.686279296875       -70.306480407715
1803.710693359375       -71.739479064941
2000.000000000000       -83.138786315918
```

LH_9_up.lim

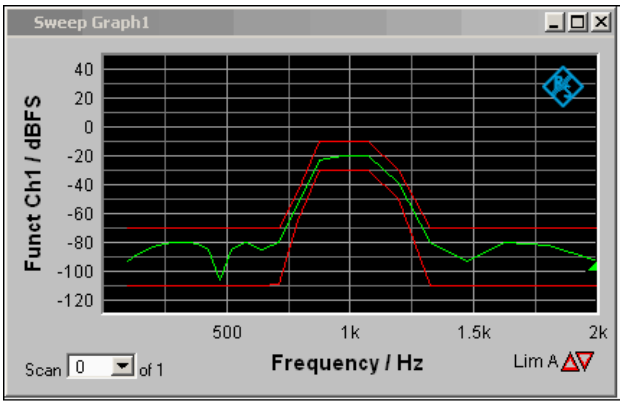
```
UPV LIMIT FILE
9 # Datacount
# Offset ON
# Offset value = 10.000000 dBV
Hz          dBV
100         -70
711         -70
789         -45
875         -10
970         -10
1076        -10
1193        -30
1323        -70
2000        -70
```

When altering the number of X/Y values it is important to make sure that the Datacount entry is adapted accordingly. The identifier **UPV LIMIT FILE** must not be changed. If the tabulator (TAB) is used as a separator between various entries in a line, the file can be processed in EXCEL without any problem. Other separators are also permissible, e.g. ';', '|' or ' '.

If the new limit curve named `LH_9_up.lim` is then loaded as "Limit Upper", the result of the modification can be assessed and further processing can be performed if necessary.



A limit file for the lower limit of a tolerance band can be generated in much the same way as the procedure for modifying a limit file for the upper limit of a tolerance band. The two limit files together produce the desired tolerance band.



Example:

The intention is to create a sweep file from the trace data set of a waveform file. Leave to one side the matter of whether this serves any purpose. The example is intended to show that any trace file can be created by editing.

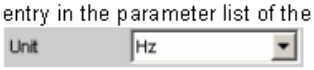
The X values in the waveform trace file are expressed in seconds. But the x-axis in the sweep trace file needs to be displayed in Hz. The level values on the y-axis are to stay unchanged.

The left column shows the original Waveform Trace file, the right table column the Sweep Trace file that was generated through editing.

```
1     UPV WAVEFORM TRACE FILE                    UPV SWEEP TRACE FILE
2     Heading String                             Heading String
3     Commenttext                                Commenttext
4     X Axis  Trace A Trace B                    X Axis  Trace A Trace B
5     Time    Level Ch1              VOID        Frequency      Funct Ch1      VOID
6     Time / s       Level Ch1 / V   VOID        Frequency / Hz  Funct Ch1 / V VOID
7     s       V              VOID                Hz      V              VOID
8     LIN     LIN            VOID                LIN     LIN            VOID
9     0       -0.000273702   VOID                0       -0.000273702   VOID
10    0.0001  0.000946001    VOID                10      0.000946001    VOID
11    VOID    VOID           VOID                VOID    VOID           VOID
12    VOID    VOID           VOID                VOID    VOID           VOID
13    Scan #0 Labeltext      VOID                Scan #0 Labeltext      VOID
14    s       V              VOID                Hz      V              VOID
15    1       1.00e+00       VOID                1       1.00e+00       VOID
16    A-X/6             A-Y                      A-X/6             A-Y
17    0.00000e+00    1.01179e-004                0.00000    1.01179e-004
18    2.08333e-05    6.25051e-004                2.08333    6.25051e-004
19    4.16666e-05    8.90560e-004                4.16666    8.90560e-004
20    6.25000e-05    7.87767e-004                6.25000    7.87767e-004
21    8.33333e-05    3.59082e-004                8.33333    3.59082e-004
22    1.04166e-04    -2.1826e-004                10.4166    -2.1826e-004
```

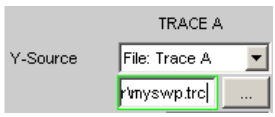
The data sets are displayed in abbreviated form.

Explanation of the changes:

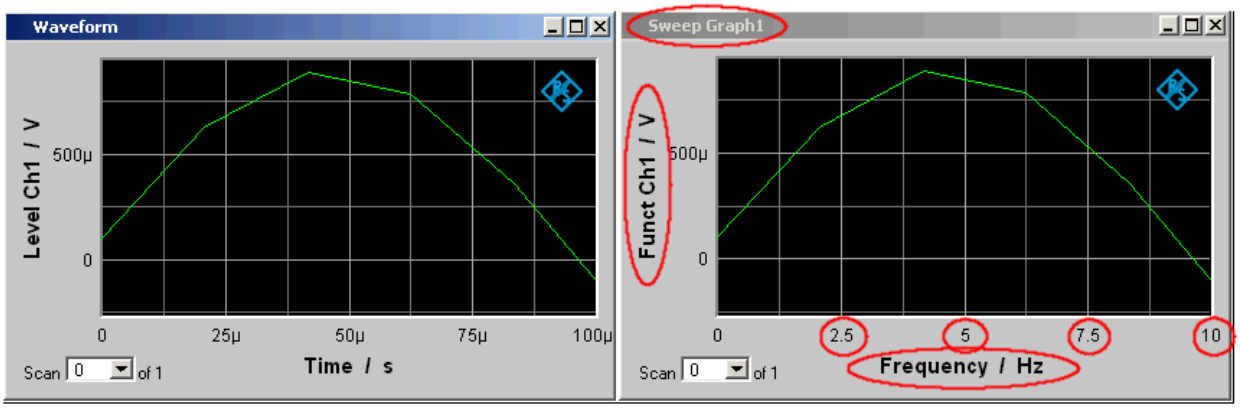
Line	Change
1	**UPV SWEEP TRACE FILE** The identifier is changed so that the file will be accepted in the sweep graphic system. For information on identifiers see table entry "Subsystem identifier" in section "Trace Files", on page 4.610
2	unchanged
3	unchanged
4	unchanged
5	**Frequency** The desired function of the X axis is entered here. The wording must be exacty the same as the entry in the parameter list of the X axis selection field. **Funct Ch1** The desired function of the Y axis is entered here. The wording must be exacty the same as the entry in the parameter list of the "Y-Source" selection field.
6	**Frequency / Hz** The desired label for the X axis is entered here: **Funct Ch1 / V** The desired label for the Y axis is entered here:
7	**Hz** The desired unit for the X axis is entered here. The wording must be exacty the same as the entry in the parameter list of the Unit selection field. 
8	unchanged
9	unchanged
10	**10** The righthand final value of the X axis is entered here.
11	unchanged
12	unchanged
13	unchanged
14	**Hz** The **basic** unit of the unit selected in line 7 is entered here. If for example ΔHz had been entered in line 7, then Hz would still have to be shown here.
15	unchanged
16	unchanged
17	
18	
19	**Modified X values**
20	
21	
22	

In order to make the changes, the waveform trace file (e.g. `mywav.trc`) is loaded into an ASCII editor, such as the Windows Editor, which is present as an accessory on every Windows operating system for the R&S UPP. The editor displays a data set as shown in the left column above. This data set is then modified as shown in the right column. The amended data set is saved with another name (e.g. myswp.trc).

After the new data set is loaded in the Sweep graphic system



a trace identical to that of the waveform must be seen, though its x-axis will be totally different.



5.53 Export

The most frequent reason for needing to export trace files, equalization files, sweep lists and limit files is without doubt so that they can be further processed in Microsoft Excel.

The procedure is explained in broad terms in the following example. The examples are really intended for the trained user. A point by point description would be beyond the scope of this description.

Changing the language option:

It is a prerequisite that Microsoft Excel is installed on the R&S UPP, or that a PC is available on which Excel is already installed.

If a PC is to be used, the trace file being exported must be copied to this PC by means of a USB stick, for example.

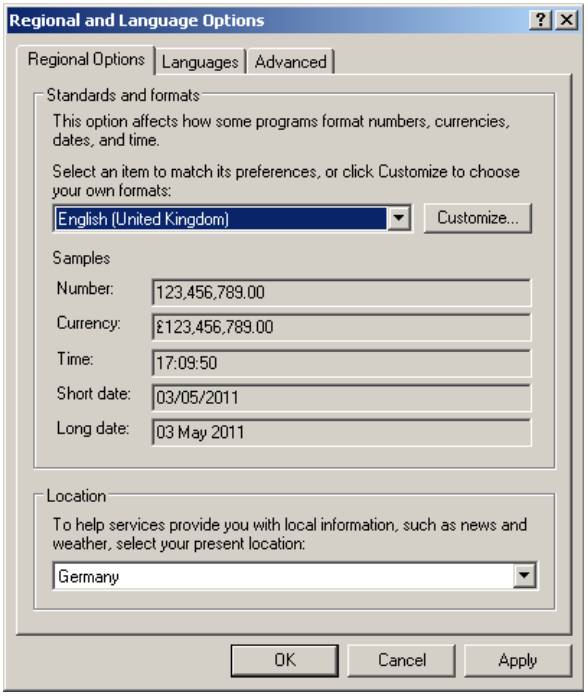
The PC must be changed over to the English language option if this has not already been done.

This is usually not necessary in the case of the R&S UPP since the R&S UPP is delivered with the language option "English (United Kingdom).

If it is necessary to change the language option, proceed as follows:

Using the operating menu sequence:

Start, Settings, Control Panel, open the window for "Regional and Language Options" and set the language "English (United Kingdom)".



This conversion ensures that in Excel the decimal separator within numbers is interpreted as the decimal point.

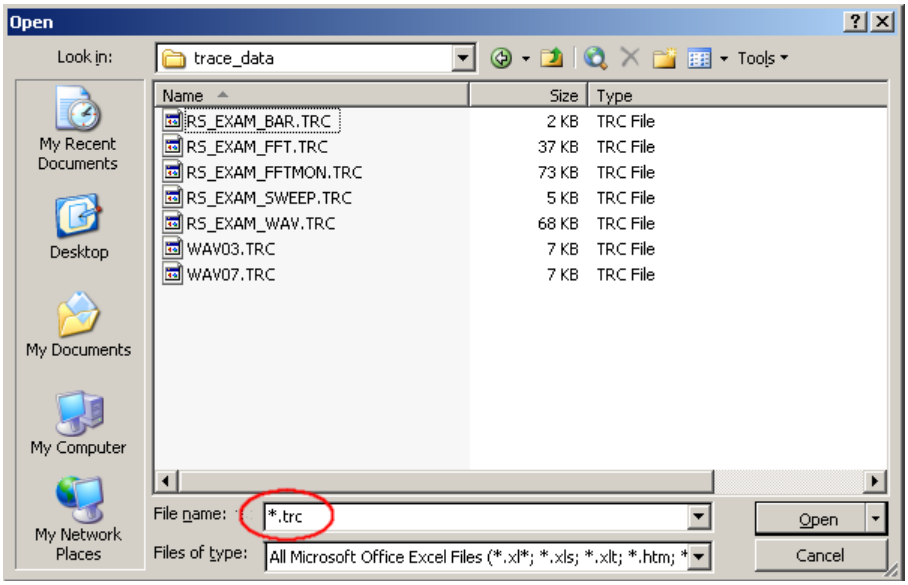
Since the R&S UPP is delivered with an English-language operating system for English-speaking regions, the trace files are generated within the R&S UPP exclusively in the English number format (decimal point rather than decimal comma) and can therefore be processed in Excel without the slightest need for post-processing.

Reading the trace file into Excel:

Open Excel and open the file selector via the menu item File Open.

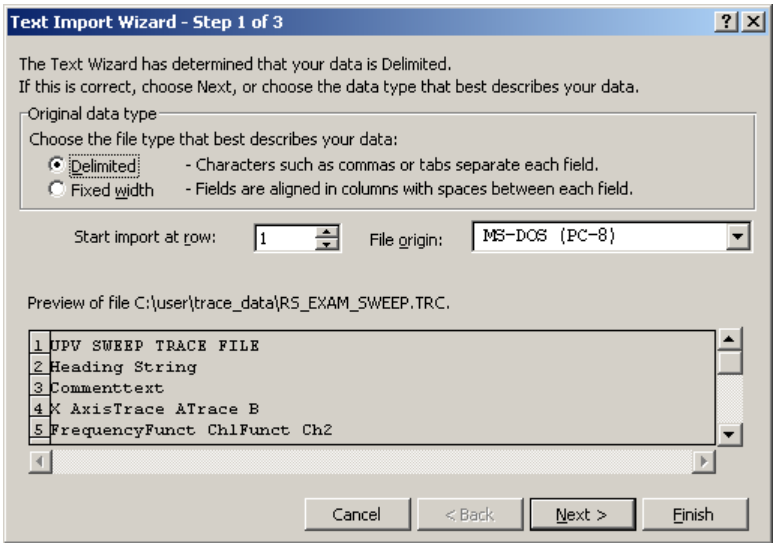
Go to the directory containing the trace file that is to be exported.

In the File name field type the file name extension `*.TRC` and all files with the extension `*.TRC` will appear.



Select the file that is to be exported.

A dialog box opens in which no changes must be made if "Start / Control Panel / Regional and Language Options" is set to the condition as supplied to the customer "English (United Kingdom)".


Text Import Wizard - Step 1 of 3
The Text Wizard has determined that your data is Delimited.
If this is correct, choose Next, or choose the data type that best describes your data.
Original data type
Choose the file type that best describes your data:
Delimited - Characters such as commas or tabs separate each field.
Fixed width - Fields are aligned in columns with spaces between each field.
Start import at row: 1
File origin: MS-DOS (PC-8)
Preview of file C:\user\trace_data\RS_EXAM_SWEEP.TRC.
1 UPV SWEEP TRACE FILE
2 Heading String
3 Commenttext
4 X AxisTrace ATrace B
5 FrequencyFunct ChlFunct Ch2
Cancel
< Back
Next >
Finish

Finish.

The trace files have been designed by R&S so that without a single entry the data set appears in Excel and can be processed further.

	A	B	C	D	E	F	G	H	I	J
1	UPV SWEEP TRACE FILE									
2	Heading String									
3	Commenttext									
4	X Axis	Trace A	Trace B							
5	Frequency	Funct Ch1	Funct Ch2							
6	Frequency / H	Funct Ch1 / V	Funct Ch2 / V							
7	Hz	V	V							
8	LIN	LIN	LIN							
9	100	0	0							
10	20000	0.15	0.17							
11	VOID	VOID	VOID							
12	VOID	VOID	VOID							
13	Scan #0	Labeltext	Labeltext							
14	Hz	V	V							
15	1000	1.00E+00	1.00E+00							
16	A-X/30	A	A-LimLow	A-LimUpp	A-RefY in V	B-X/30	B	B-LimLow	B-LimUpp	B-RefY in V
17	1.00E+02	1.12E-02	VOID	VOID	1.00E+00	1.00E+02	1.12E-02	VOID	VOID	1.00E+00
18	1.20E+02	1.48E-02	VOID	VOID	1.00E+00	1.20E+02	1.49E-02	VOID	VOID	1.00E+00
19	1.44E+02	1.92E-02	VOID	VOID	1.00E+00	1.44E+02	1.92E-02	VOID	VOID	1.00E+00
20	1.73E+02	2.44E-02	VOID	VOID	1.00E+00	1.73E+02	2.44E-02	VOID	VOID	1.00E+00
21	2.08E+02	3.04E-02	VOID	VOID	1.00E+00	2.08E+02	3.04E-02	VOID	VOID	1.00E+00
22	2.49E+02	3.73E-02	VOID	VOID	1.00E+00	2.49E+02	3.73E-02	VOID	VOID	1.00E+00
23	2.99E+02	4.50E-02	VOID	VOID	1.00E+00	2.99E+02	4.50E-02	VOID	VOID	1.00E+00
24	3.59E+02	5.34E-02	VOID	VOID	1.00E+00	3.59E+02	5.35E-02	VOID	VOID	1.00E+00

If the Language Option is changed, an adaptation of the "Decimal separator" and the "Thousands separator" is necessary, to be configured under Text Import Wizard - Step 3 of 3, "Advanced ..." button.

To obtain an EXCEL file that is similar to the original Trace file, we recommend formating all cells with "Scientific" with 12 trailing digits.

5.54 Loading and Saving

This section tells you how to load and save different kinds of data sets in the R&S UPP. The file name is chosen through a central file selection box. Its type is defined by the extension.

5.54.1 Windows File Selection Box

The Windows file selection box is split into three areas: On the left is a selection bar of icons which can be used to jump to different drives and personal directories.

In the upper area are the navigation buttons for such things as changing directories or creating new directories. Directly below is a list of the displayed files.

In the lower area is the entry field for the file name and the buttons for confirming the selection. If files have already been selected in previous steps, the file selection box remembers their names and offers the first matching name from the history as a preselection when a file name is being typed.

As usual in Windows programs, this file selection box is best operated with the mouse only.

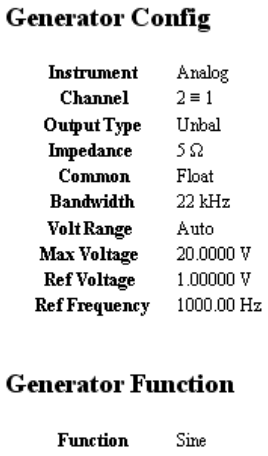
5.55 Loading and Saving Setups

Setups can be loaded and saved at any time. Loading and saving setups is performed through the menu bar and button "File ". ALT + L for LOAD and ALT + S for SAVE also trigger these functions.

5.55.1 Saving Setups

When saving setups, the R&S UPP distinguishes three types, namely complete setups (`*.set`) , current setups (`*.sac`) and a report file for visualizing the settings in HTML format (`*.html`) .

- Complete Setup
  Saving a complete setup saves the entire instrument settings, plus the position and size of all windows in all screens.
- Current setup
  Saving a current setup, in contrast, only saves the instrument settings. A setup saved in this way can be loaded much faster, since the panels do not have to be restored.
- Report File
  This file can be opened and viewed in Internet Explorer or a similar browser.



Generator Config

Instrument	Analog
Channel	2 ≡ 1
Output Type	Unbal
Impedance	5 Ω
Common	Float
Bandwidth	22 kHz
Volt Range	Auto
Max Voltage	20.0000 V
Ref Voltage	1.00000 V
Ref Frequency	1000.00 Hz

Generator Function

Function	Sine

Remote-control command:`MMEMory:STORe:STATe`

5.55.2 Loading Setups

Loading a setup overwrites the settings of the instrument with the settings that were active when setup was saved. Depending on the type of setup to be loaded, only the current settings are overwritten ("current" setup) or the entire settings, including the position and size of all windows in all screens ("complete" setup). Windows that were open when the setup was saved are opened, and windows that were closed when the setup was saved are closed again. This is also done for the screens that are not visible.

Report files with the ending *.html cannot be loaded as setup. They merely serve for visualizing settings.

Remote-control command: MMEMory:LOAD:STATe on page 794

5.56 Printing and Saving

5.56.1 Printing and Saving the Display Screen

The R&S UPPenables you, at any time, to make and keep an extract of the displayed results for later use. You do this either by a direct printout or by saving to a file or the Windows clipboard. You make the necessary settings, e.g. selection of the result to be output (source) and where it is to be output (destination), in a configuration panel.

5.56.1.1 Printing the entire display screen

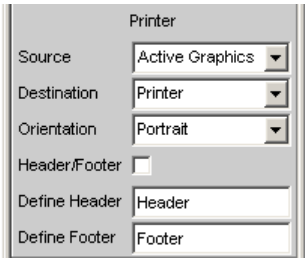
If the entire display screen is printed out, all panels are printed exactly as positioned on the screen. All colors are retained as they are, e.g. measured values are printed in green on a black background. This output mode is less suitable when printing only one graphic, for example. For this purpose, printout of a graphical window as a vector graphic is to be selected.

5.56.1.2 Printing of graphical windows as vector graphics

In this mode, graphical windows can be printed as vector graphics. This has two advantages: First, the printout is performed with maximum printer resolution. This means that an FFT with, for example, 2048 samples can also be printed without any problem in this resolution on DIN A4 with 600 dpi. In contrast, a screen printout could only differentiate a maximum of 800 samples, because it is always coupled to the screen resolution. Second, a black and white printer is used; this means that the background of the graphic remains white and the curves for the traces are printed out in black. Trace A is assigned a solid line, trace B a dotted line.

5.56.2 Configuring Print and Save Operations

The menu "Utilities", "Config Panel", section "Printer" opens a configuration panel for defining the required output parameters.



See "Source" on page 471.

5.56.3 Starting Print and Save Operations

HCOPY triggers the function to output measured value results. Depending on the selected setting in the configuration panel (see chapter 5.56.2, "Configuring Print and Save Operations", on page 607), the desired action is carried out immediately.

Remote-control command:

`HCOPy[:IMMediate]` on page 792

If you trigger H Copy during an ongoing measurement, the measurement is first halted and then the action is executed.

6 Remote Control - Fundamentals

6.1 Remote Control - Fundamentals

6.1.1 Introduction - Remote Control Fundamentals

In this chapter you will find:

- instructions on starting the Audio Analyzer R&S UPP by remote control,
- a general introduction to the remote control of programmable instruments, including details of command structure and syntax, command processing and the status registers,
- a graphic and tabular presentation of the status registers used in the Audio Analyzer R&S UPP,

The remote control commands of the Audio Analyzer R&S UPP are included in Chapter 5, "Instrument functions," and Chapter 7, "Remote control - commands."

To standard the instrument comes with the following interfaces for remote control:

- IEC/IEEE bus interface in line with the IEC 625.1/IEEE 488.2 standard.
- LAN interface; the network card uses 100 MHz Ethernet IEEE 802.3u; the protocol is based on the VXI-11 standard.
- USB interface (device USB)

A controller can be connected on the remote control interfaces, either direct via IEC-bus, USB interface or through a network (LAN). The connectors are located on the rear panel of the instrument.

Remote control via IEC/IEEE bus and USB interface are identical concerning the requirements. The differences to remote control via LAN are minor, they will be described in greater detail below. If remote control via IEC/IEEE bus is described below it also includes remote control via the USB interface!

These connectors are detailed in chapter 9 Maintenance and Interfaces.

SCPI commands (messages) are used for remote control. Commands not derived from the standard nevertheless follow SCPI syntax rules. The instrument supports SCPI version 1999 (Standard Commands for Programmable Instruments). The SCPI standard sets up on the IEEE 488.2 standard, and aims at standardization of device-specific commands, error handling and status registers. For more information on the SCPI concept and definitions, refer to the book "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" by John M. Pieper, R&S ordering number 0002.3536.00.

For the purposes of this chapter it is assumed that you are familiar with the programming and operation of the controller. Refer to the appropriate manuals for details of the interface commands.

The requirements of the SCPI standard in terms of command syntax, error handling and configuration of status registers are explained in detail in the respective sections. Tables give you a fast overview of the bit assignments in the status registers. The tables are supplemented by a detailed description of the status registers.

All program examples for IEC/IEEE bus control are written in Visual Basic. A requisite for Visual Basic programming is that the modules NIGLOBAL (Niglobal.bas) and VBIB32 (Vbib_32.bas) are added to the projects.

Manual control aims at the greatest possible operating ease. The focus in remote control is the predictability of device status after a command. Consequently, remote control programs should always produce a default status to start with (e.g. by the *RST command) and then make the required settings.

6.2 Brief Instructions

The following short and simple operating sequence allows rapid setup of the instrument on the IEC/IEEE bus and setting of its basic functions. It is assumed that the IEC/IEEE bus address, factory-set to 20, has not yet been altered.

Interconnect the instrument and the controller by the IEC/IEEE bus cable and power them on.

Connect generator output channel 1 and analog analyzer channel 1 using a XRL cable.

6.2.1 IEC Bus

Generate and start the following program on the controller:

CALL IBFIND("DEV1", analyzer%)	Open channel to device.
CALL IBPAD(analyzer%, 20)	Send device address to controller.
CALL IBWRT(analyzer%, "*RST;*CLS")	Reset device, analog generator is set dual-channel to 1 kHz, 0,1 V. Measurement function of analog analyzer is set dual-channel to RMS measurement.
CALL IBWRT(analyzer%, "INIT:CONT OFF;*WAI")	Trigger single measurement result.
CALL IBWRT(analyzer%, "SENS1:DATA1?")	Request function measurement result (i.e. result of RMS measurement) from channel 1.
CALL IBRD (analyzer%, M$)	Read in measurement result.
PRINT M$	Output measurement result on-screen.

The screen of the controller displays the RMS function measurement result (volt) of the generator signal which was measured using the XLR cable.

If a monitor, an external keyboard and a mouse are connected, return to manual control: press key CTRL+F11.

6.3 Changing to Remote Control

After powering on, the instrument is always in manual control status (LOCAL) and can be controlled from an external monitor, external keyboard and mouse.

To operate the instrument by remote control via an IEC/IEEE bus, you have to switch it to the REMOTE mode by sending an addressed command while the REN line is set. Otherwise, the instrument will remain in the LOCAL mode. If the REN line is cleared while the instrument is in the REMOTE mode, the instrument automatically resets to LOCAL.

For remote control via Ethernet (LAN), the changeover does not take place automatically by sending a command; rather, the instrument must be set to REMOTE status explicitly, e.g. by sending the interface command **&GTR** (Go-To-Remote).

In REMOTE status, instrument control from by a mouse and keyboard is disabled. But the panels can be opened by the mouse and keyboard to verify settings for example.

In the Config Panel (in the menu Utilities) you can choose whether or not the panels are to be updated during remote control with the parameter field "SCPI Update".

In the middle of the screen you see the message "Remote Operation Active". On the front panel the LED labeled REM illuminates over the Standby key.

Messages appearing during remote control are shown in the status line over the softkeys.

The instrument remains in the REMOTE status until local control is selected either manually with the CTRL+F11 or in the "Remote Operation Active" window with a mouse click on **X** or by the interface command **&GTL**. Processing of a command must be completed before changing, otherwise there is an immediate return to remote control. Then the panels are updated.

Changing from manual control to remote control and vice versa does not change the instrument settings.

6.3.1 Remote Control by IEC/IEEE Bus

To be able to control the instrument on the IEC/IEEE bus interface, the instrument and controller must be linked by an IEC/IEEE bus cable. The controller must have an IEC/IEEE bus card, the card drivers and the program libraries for the programming language that is used.

The controller must address the instrument by the set IEC/IEEE bus address. The IEC/IEEE bus address of the instrument is factory-set to 20. It can be altered in the Config Panel (in the Utilities menu) with the "GPIB Address" parameter field.

Addresses from 1 to 30 are permissible. After setting a new address, the device status of the R&S UPP is saved with the new address. This prevents the R&S UPP from „forgetting" the new address if switched OFF with the power switch rather than being properly shut down.

Sending the first command starts remote control.

6.3.2 Remote Control via LAN Interface

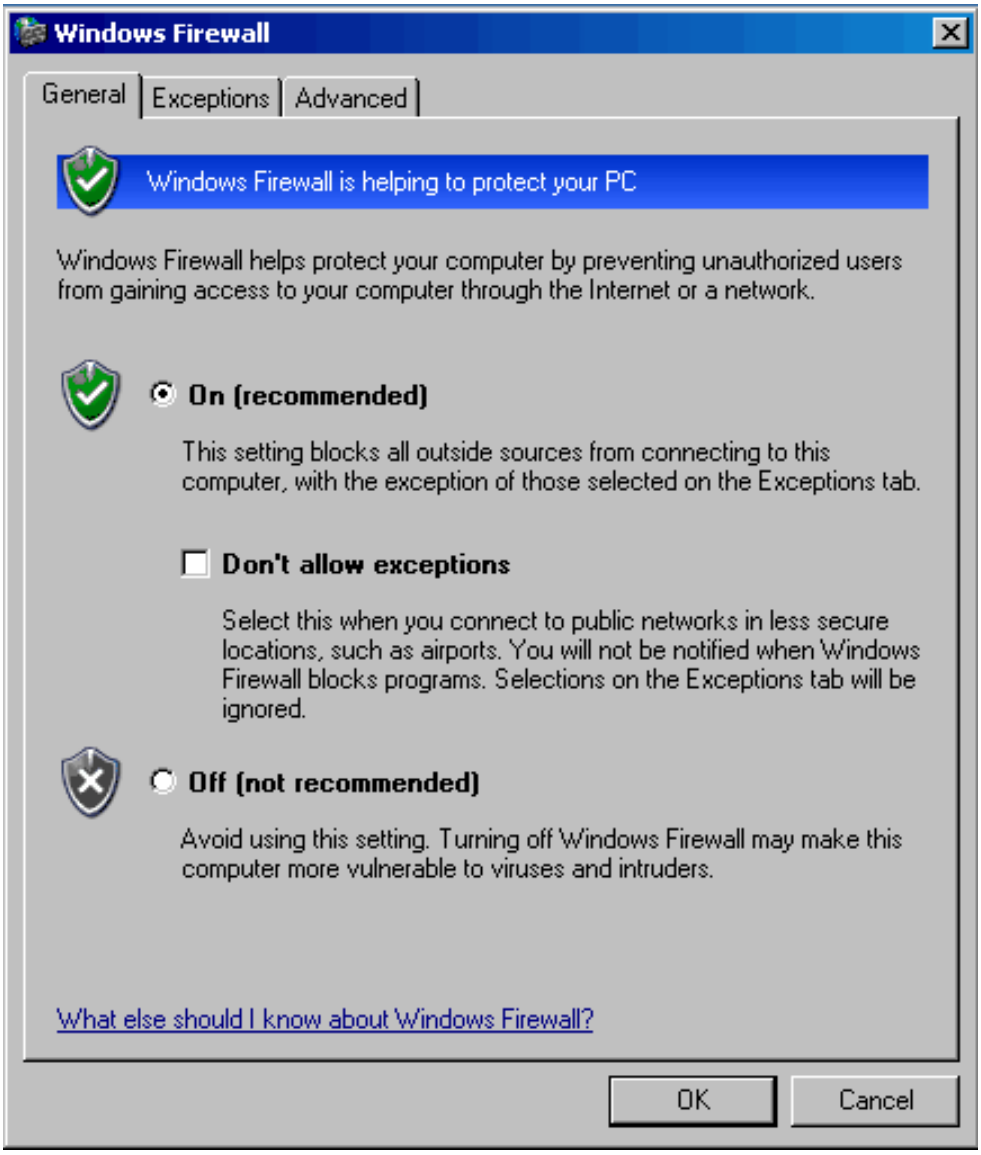
For remote control through a network, the controller and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol.

Connection of the R&S UPP to a network and querying of the computer name is explained in chapter 2.10, "Connect R&S UPP to a Network (LAN)", on page 44.

R&S UPP is supplied with an activated Windows XP* firewall already installed. In contrast to file transfer via a LAN or manual remote operation with Remote Desktop, which requires only partial disablement (exception) in the firewall, remote control via a LAN is possible only if the firewall is completely deactivated.

Setting remote control:

"Start" - "Programs" - "Windows Firewall" - "Off (not recommended)":


Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
What else should I know about Windows Firewall?
OK
Cancel

NOTICE

Possible damage of an unprotected controller

Reactivate the Windows XP firewall after you terminate VISA Remote Control setting "On (recommended)"), to protect the instrument from users and programs that can access a computer via the network.

Software for instrument control and the VISA program library must be installed on the controller. Instrument control is by the VXI-11 standard protocol.

Only the IP address or the computer name is required for connection setup. The IP address/computer name is part of the "resource name" used by programs to identify and control the instrument. The resource name has the form:

TCPIP::ipaddr::inst0::INSTR

Replace **ipaddr** by the IP address or the computer name of the instrument. For instance, if the instrument has the IP address 192.1.2.3, TCPIP::192.1.2.3::inst0::INSTR is the valid resource name. The specification of **inst0** in the resource name is optional and may be omitted. So in this example TCPIP::192.1.2.3::INSTR is also a valid resource name. A resource name with computer name could be TCPIP::RSUPP1::INSTR.

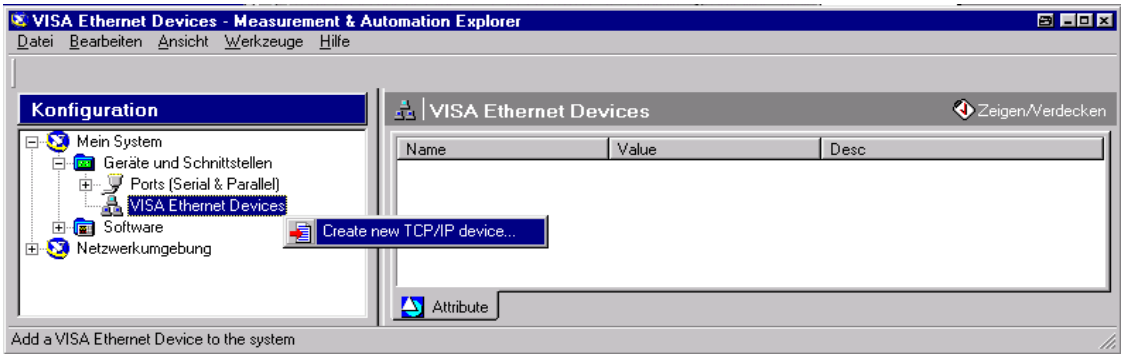
If LXI is installed, the IP address of the instrument can be determined easily by using a Web browser. See chapter 2.10.3, "Configuration via LXI", on page 49.

TCPIP designates the network protocol used and **INSTR** indicates that the VXI-11 protocol is used. If several instruments are connected to a network, each instrument has its own IP address and associated resource name. The controller distinguishes these instruments by their resource name.

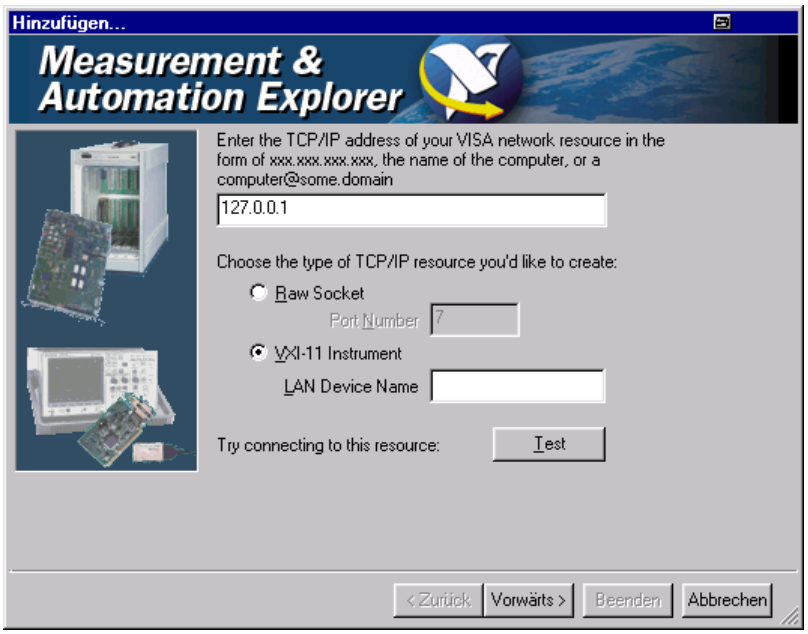
In the example below, the Measurement & Automation Explorer program from National Instruments is used to set up an Ethernet remote control connection. Connection setup with this program is simple and first tests can be performed. R&S UPP is ready configured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, the computer name must be entered at the position of the IP address. It is also possible to assign the R&S UPP a fixed IP address (see chapter 2.10, "Connect R&S UPP to a Network (LAN)", on page 44).

Configuring the control of R&S UPP in the 'Measurement & Automation Control' program

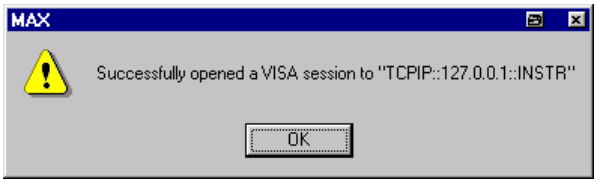
- Launch the program on the control computer.
- Menu "Create new TCP/IP device" with the right mouse key

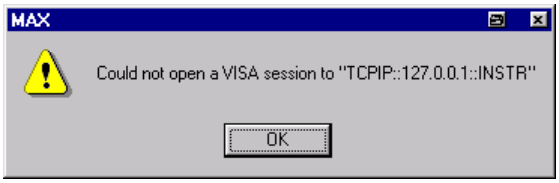


- Enter the IP address of the R&S UPP and select "VXI-11 Instrument" (You can also enter the computer name).

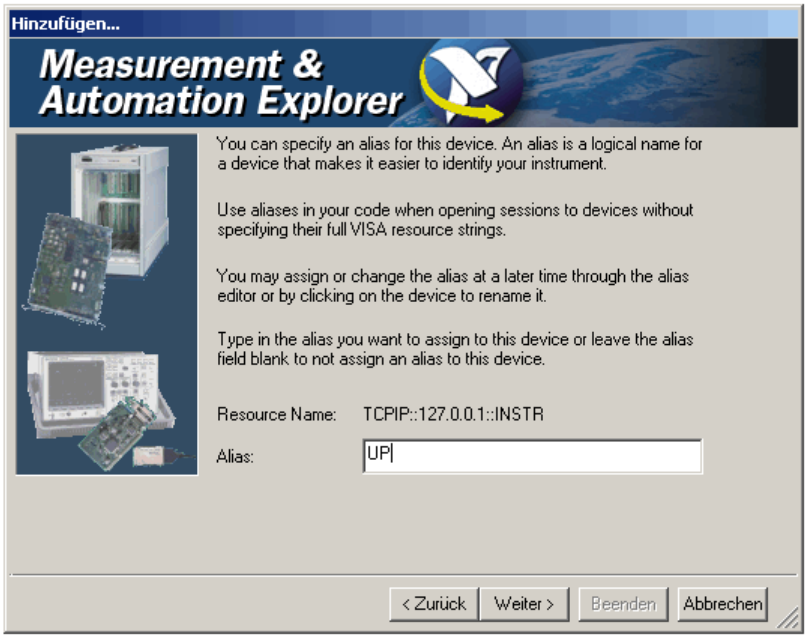

Hinzufügen...
Measurement & Automation Explorer
Enter the TCP/IP address of your VISA network resource in the form of xxx.xxx.xxx.xxx, the name of the computer, or a computer@some.domain
127.0.0.1
Choose the type of TCP/IP resource you'd like to create:
Raw Socket
Port Number
7
VXI-11 Instrument
LAN Device Name
Try connecting to this resource:
Test
< Zurück
Vorwärts >
Beenden
Abbrechen

- Press the "Test" button. A message indicates whether the connection to the R&S UPP can be set up or not. If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and powered on. Correct spelling of the IP address or the computer name can also be checked. For further troubleshooting it is advisable to inform the network administrator. Large networks require specification of additional addresses for connection setup, e.g. gateway and subnet mask, which are known to the network administrator.

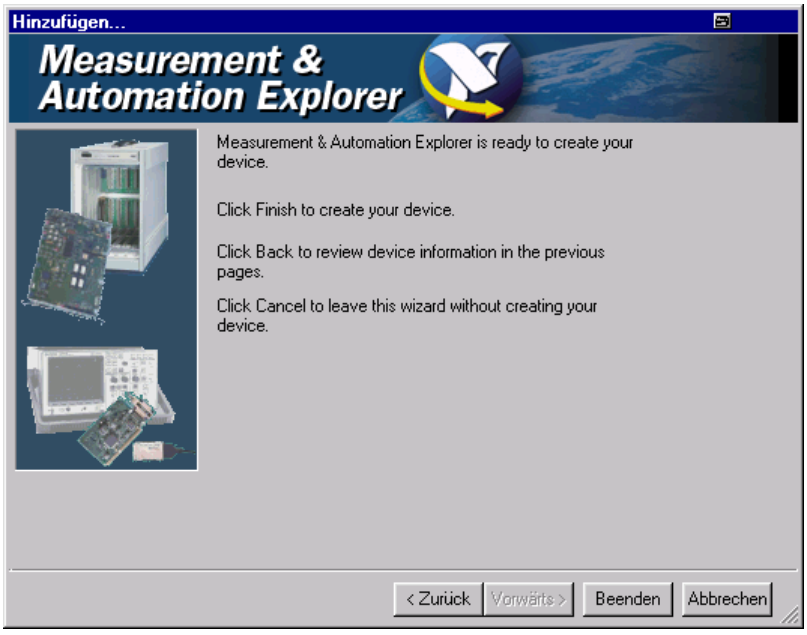




- Press the "Next" button.In the next window you can enter an alias for the instrument. This name must not be mistaken for the computer name. It is only used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.

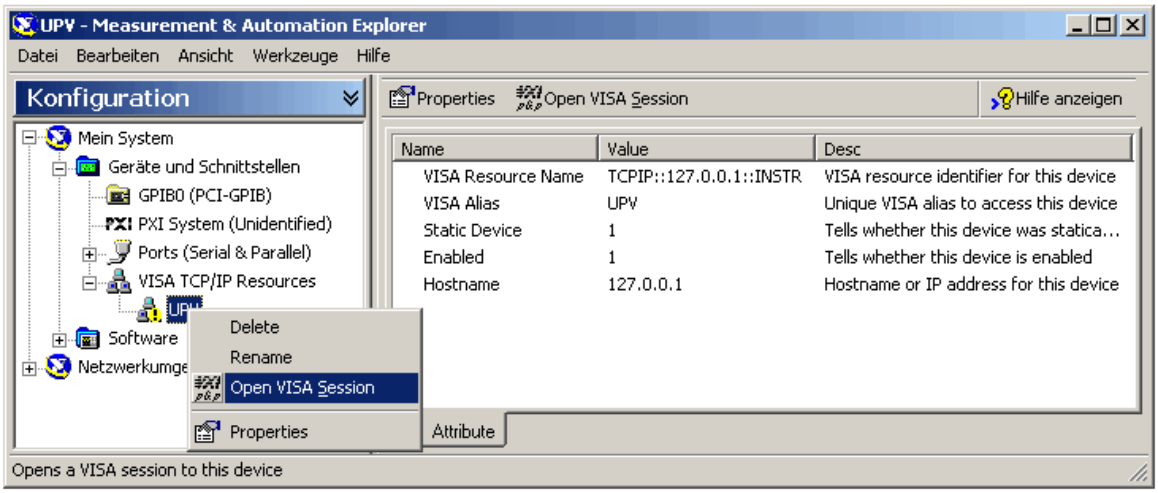

Hinzufügen...
Measurement & Automation Explorer
You can specify an alias for this device. An alias is a logical name for a device that makes it easier to identify your instrument.
Use aliases in your code when opening sessions to devices without specifying their full VISA resource strings.
You may assign or change the alias at a later time through the alias editor or by clicking on the device to rename it.
Type in the alias you want to assign to this device or leave the alias field blank to not assign an alias to this device.
Resource Name: TCPIP::127.0.0.1::INSTR
Alias: UP
< Zurück
Weiter >
Beenden
Abbrechen

- Press the "Next" and then the "Finish" button. The instrument is now configured in the program and can be addressed by the resource name or alias.

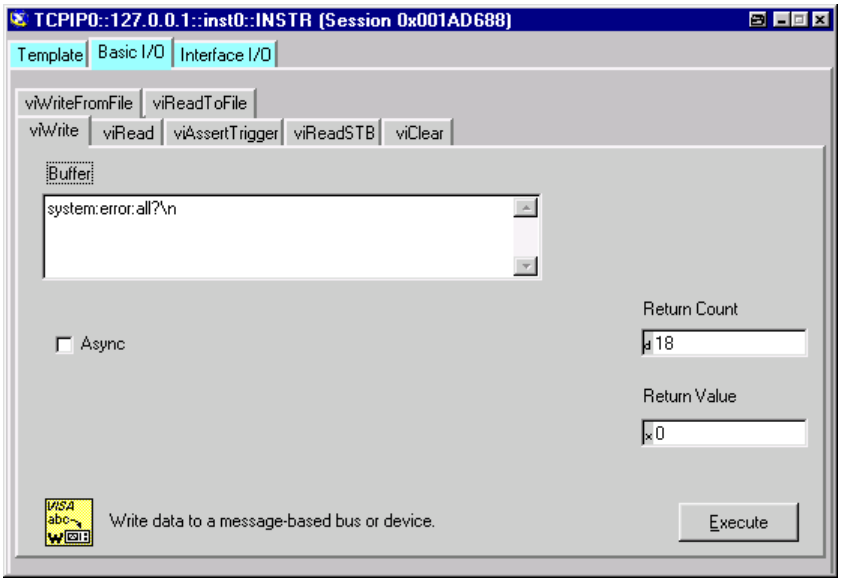

Hinzufügen...
Measurement & Automation Explorer
Measurement & Automation Explorer is ready to create your device.
Click Finish to create your device.
Click Back to review device information in the previous pages.
Click Cancel to leave this wizard without creating your device.
< Zurück
Vorwärts >
Beenden
Abbrechen

Starting the "Measurement & Automation Control" program for remote control of the R&S UPP.

- Launch the program on the control computer.
- Open panel "Configuration Instruments and Interfaces" and select under "VISA Ethernet Devices" Instrument R&S UPP (=Alias)
- Open the "Open VISA Session" menu with the right mouse key.



- On the "viWrite" tab in the "Basic I/O" panel, commands can be sent to the instrument; instrument responses are displayed on the viRead tab (for further program operation refer to the online help).



Returning to manual control is possible from the front panel or on the LAN interface.

6.3.3 Remote Control via the USB Device Interface

For remote control via the USB bus, the control computer and the instrument must be connected by a USB cable. A program for controlling instruments, such as the VISA

program library with USB support (Version 3.4 or later) must be installed in the control computer. The instrument is controlled via the standardized USB protocol.

The only information necessary for establishing a link is the USB Vendor ID of Rohde&Schwarz (0x0AAD), the Class ID of the R&S UPP (0x004D) and the serial number of the instrument. These IDs form part of the resource name, which the programs use to identify and control the instrument. The resource name has the form:

USB::0x0AAD::0x004D::serialnum::INSTR

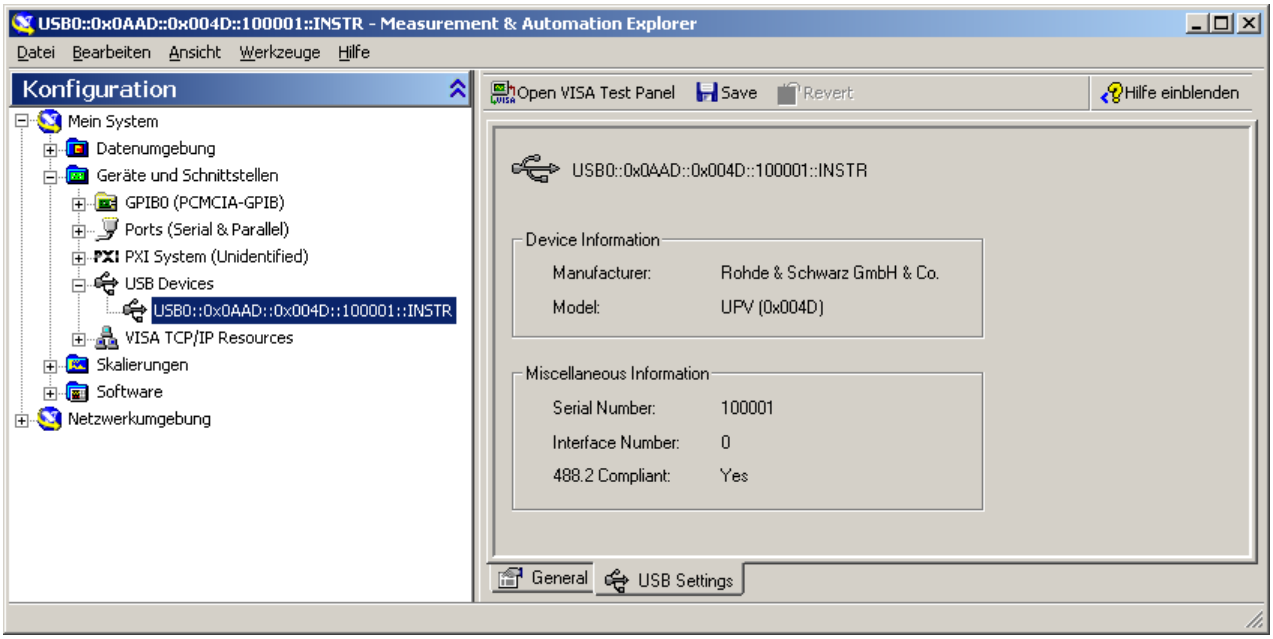
Here **serialnum** must be replaced by the serial number of the instrument. For example, if the serial number of the instrument is 100534, the valid resource name is **USB::0x0AAD::0x004D::100534**.

USB designates the interface that is used. If multiple instruments are connected to the USB bus, each instrument has its own serial number and thus its own associated resource name. The controller distinguishes these instruments by their resource name.

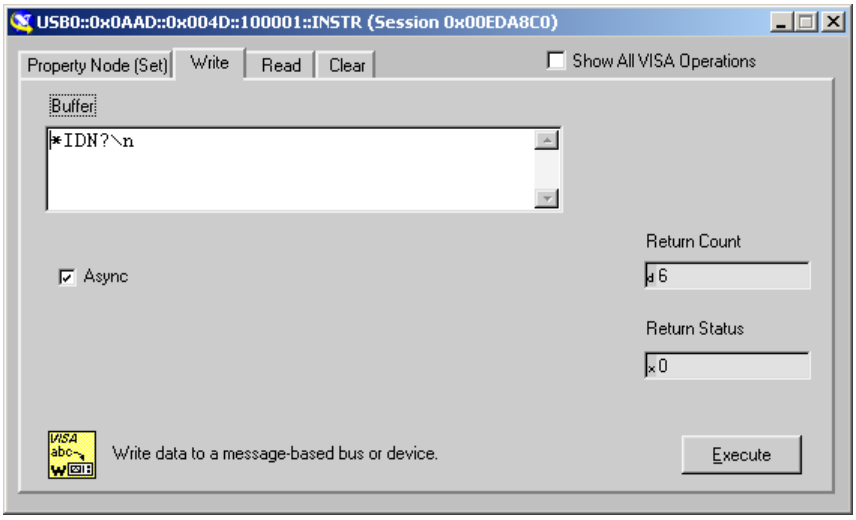
The National Instruments "Measurement & Automation Explorer" program is used in the following example of USB remote control setup. This program makes it easy to establish a connection and get started with testing.

Configuring the control of R&S UPP in the 'Measurement & Automation Control' program

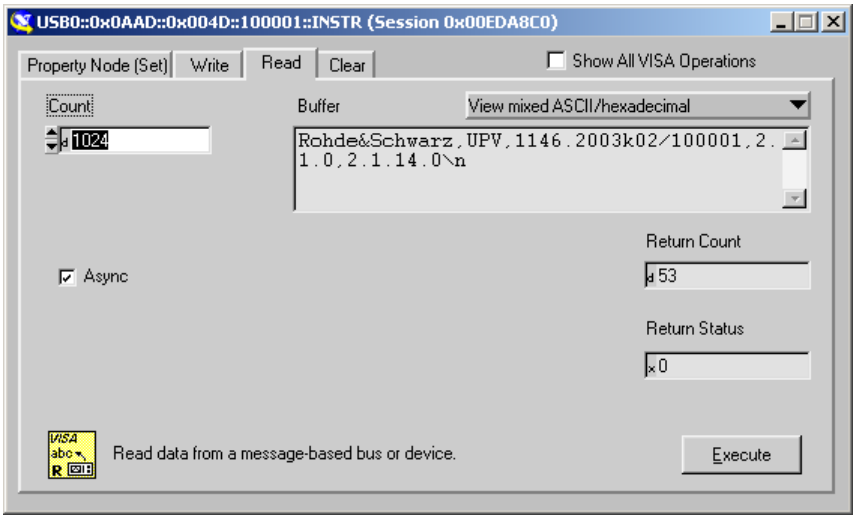
- Launch the program on the control computer.
- Open "USB Devices" in the Instruments and Interfaces window and select
- R&S UPP.



- Press the "Open VISA Test Panel" button.
- Select the "Write" tab and press the "Execute" button



- Select the "Read" tab and press the "Execute" button.



If the link is working properly, the identification string of the R&S UPP will be displayed here.

6.4 Messages

The messages transmitted on the data lines of the IEC/IEEE bus or on a TCP/IP network can be divided into two groups:

- Interface messages
- Device-dependent messages

6.4.1 Interface Messages

Interface messages are transmitted on the data lines of the IEC/IEEE bus when the ATN control line is active. They are used for communication between the controller and

the instrument and can only be sent by a controller which has controller functionality on the IEC/IEEE bus.

Interface messages can be further classified as

- – Universal commands
- – Addressed commands

Universal commands affect all devices connected to the IEC/IEEE bus without requiring an address, whereas addressed commands only affect devices addressed as a listener. The interface messages relevant for a device are listed in chapter 9.4, "Instrument Interfaces", on page 838.

If an Ethernet connection is present, signaling on a hardware control line is not required. The IEC/IEEE bus interface commands are emulated (see chapter 9.4, "Instrument Interfaces", on page 838).

6.4.2 Device-Dependent Messages

Device-dependent messages are transmitted on the data lines of the IEC/IEEE bus when the ATN control line is not active. ASCII code is used for data transmission.

If an Ethernet connection is present, signaling on a hardware control line is not required.

Device-dependent messages are identical for the two interfaces (IEC/IEEE bus and Ethernet). They are differentiated by the direction in which they are sent:

Commands (program messages)

are messages sent by the controller to a device. They operate device functions and request information.

These commands are in turn differentiated by two criteria:

1. The effect they have on the device:

Setting commands	trigger device settings, e.g. a device reset or setting of the generator frequency.
Queries	cause data to be put in the output queue, e.g. for device identification or querying a setting. These commands are formed by adding a question mark to the setting command.

2. Their definition in the IEEE 488.2 and SCPI standard:

Common Commands	are precisely defined by the IEEE 488.2 standard in function and notation. They relate to functions such as the management of standard status registers, reset and self-test.
Device-specific commands	relate to functions that depend on device characteristics such as the frequency setting. A large number of these commands are also standardized by the SCPI consortium. Device-specific extensions following SCPI rules are permitted by the standard.

Device responses (response messages and service request)

are messages sent by a device to the controller after a query. They can include measurement results, device settings or information about device status (see chapter 6.5.2, "Responses to Queries", on page 624).

The structure and syntax of device-dependent messages are explained in the following section.

6.5 SCPI Command Structure and Syntax

Commands consist of a header and usually one or more parameters. The header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. space). Headers may be composed of several keywords. Queries are formed by adding a question mark direct to the header.

The commands used in the following examples are not implemented in the instrument in every case.

Common Commands

Non-device-specific commands consist of a header preceded by an asterisk "*" and possibly one or more parameters.

Examples:

*RST	`RESET`, resets the instrument
*ESE 253	`EVENT STATUS ENABLE`, sets bits of the Event Status Enable Register
*ESR?	`EVENT STATUS QUERY`, queries of the content of the Event Status register.

Device-specific commands

Hierarchy:

Device-specific commands have a hierarchic structure (see figure below). The different levels are represented by compound headers. Headers at the highest level (root level) have one keyword only. This keyword identifies a whole command system.

Example:

```
SOURce
```

This keyword identifies the SOURce command system.

For commands at lower levels the whole path has to be stated. This starts left with the highest level, and the individual keywords are separated by a colon ":".

Example:

```
SOURce:VOLTage:OFFSet:STATe ON
```

This command is on the fourth level of the SOURce system. It sets the DC offset of the generator signal.

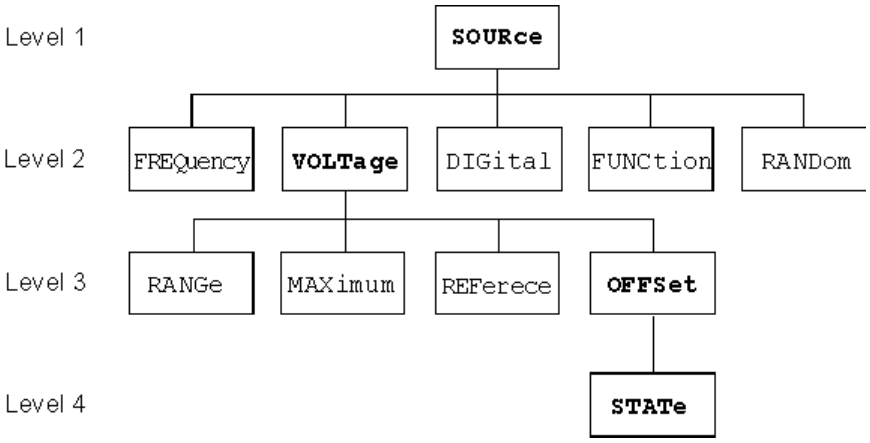


Fig. 6-1: Tree structure of SCPI command systems taking SOURce system as example (extract)

Command level:	Some keywords appear at several levels within a command system. Their effect then depends on the command structure, i.e. where they are inserted in the command header.
	Example:
	`SENSe:REFerence:MODE VALue | …`
	This command contains the keyword `REFerence` in the second command level.
	It specifies that the reference value for referenced units in the function measurement system is entered as a value (by a separate command).
	`SOURce:DIGital:REFerence AZERo | AONE`
	This command contains the keyword `REFerence` in the third command level.
	It specifies that the data of the digital reference generator are all 0 or 1.

Optional keywords:	In some command systems it is possible to insert certain keywords in the header or omit them. These keywords are identified in the manual by square brackets. For reasons of compatibility with the SCPI standard, the device must be able to recognize the full length of the command. Some commands become considerably shorter when the optional keywords are omitted. **Example:** `INSTrument[1][:SELect] ANLG | DIG` This command sets the generator to analog or digital signal generation. The following command has the same effect: `INSTrument[1][:SELect] ANLG | DIG` means that the command can be sent to the instrument in its detailed form as `INSTrument1:SELect ANLG | DIG`. The command `INSTrument ANLG | DIG` without the keywords identified by brackets has the identical effect **Note:** An optional keyword cannot be omitted if its effect is specified in more detail by a numeric suffix. In the R&S UPP this applies to the keyword SENSe for example, which can always be omitted for the function measurement = SENSe1, but must always be entered for the • input measurement = SENSe2, • frequency/phase measurement = SENSe3 and SENSe4, • FFT monitor = SENSe5 • level monitor = SENSe6 • for the waveform monitor = SENSe7 but must always be specified.
Long and short form:	The keywords have a long form and a short form. Keywords may be entered in long or in short form; other abbreviations are not allowed. **Examples:** `SENSe:POWer:REFerence:RESistange <nu> = SENS:POW:REF:RES <nu>` **Note:** Upper- and lower-case letters are only used to identify the long and short form in the manual; the device itself does not differentiate between the two types of characters.

Parameter:	Parameters must be separated from the header by a "white space". If a command contains several parameters, they are separated by a comma.
	Example:
	`OUTPut:SAMPle:FREQuency 48000 HZ`
	`TRACe:SWE:STORe:AX 1.1,1.2,1.3,1.4`

Numeric suffix:	If an instrument has several identical functions or features, e.g. inputs, the desired function can be selected by a suffix to the command. Entries without a suffix are interpreted as having a suffix 1. Optional keywords must be specified if they select a function with the suffix.
	Example:
	`SENSe[1]:FUNCtion RMS`
	`SENSe2:FUNCtion IPE`
	`SENSe6:FUNCtion LRMS`
	`SENSe7:FUNCtion ON`
	These commands activate the measurement functions Function, Input and Level Monitor. The keyword SENSe and the numeric suffixes 2 and 6 must be entered in the command.
	Note:
	In case of remote control, suffix counting may differ from the numbers of the corresponding selection used in manual control. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is stated.

6.5.1 Structure of a Program Message

A program message can contain one or more commands. It is terminated by a <New Line> (ASCII code 10 decimal) or <EOI> (EOI line active) together with the last useful character of the program message. Seeing as the <Carriage Return> character (ASCII code 13 decimal) has no effect as a filler before the end character, the combination <Carriage Return><New Line> is also admissible.

Several commands in a program message are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ':' at the beginning of a command marks the root node of the command tree, but can be omitted.

Example:

```
:SENSe:VOLTage:RANGe:MODE FIX;:INPut:MCHannels1 ON
```

This program message contains two commands. The first command belongs to the SENSe system and is used to set a fixed range. The second command belongs to the INPut system and activates channel 1.

If the successive commands belong to the same system and therefore have one or more common levels, the program message may be shortened. The second command following the semicolon then starts at the level below the common levels (see also Fig. 5-1 Tree structure of SCPI command systems taking SOURce system as example (extract)).

The colon after the semicolon must then be omitted.

Example:

```
:DISPlay:SWEep:A:TOP 10 DBFS;:DISPlay:SWEep:A:BOTTom -170 DBFS
```

This program message is shown in **full length** and contains two commands separated by a semicolon. Both commands belong to the `DISPlay` system and its `SWEep` subsystem, i.e. they have two common levels.

In the shortened program message the second command starts at the level below `DISPlay:SWEep`. The colon after the semicolon is omitted.

The shortened form of the program message is:

```
:DISP:SWE:A:TOP 10 DBFS;BOTT -170 DBFS
```

A new program message always starts with the full path however.

Example:

```
:DISPlay:SWEep:A:TOP 10 DBFS
```

```
:DISPlay:SWEep:A:BOTTom -170 DBFS
```

An optional keyword cannot be omitted if its effect is specified in more detail by a numeric suffix:

Example:

`:DISPlay:SWEep1:A:TOP 10 DBFS;:DISPlay:SWEep2:A:BOTTom -170 DBFS`

cannot, as shown in the example above, be abbreviated, as the keywords SWEep**1** and SWEep**2** have different meanings due to the suffix: SWEep**1** addresses the first sweep graphic subsystem, SWEep**2** the second.

6.5.2 Responses to Queries

Unless expressly specified otherwise, a query is defined for each setting command, which returns the current **value**. It is formed by adding a question mark to the associated setting command. The question mark can be supplemented with MIN or MAX to query the current **value range** of a numeric parameter.

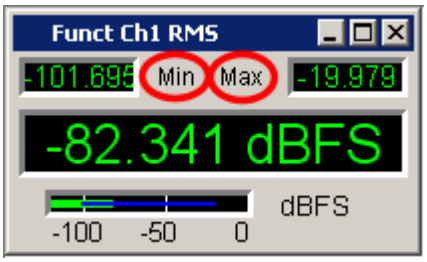
The commands with which measurement results are read out have a **special status**. A question mark extended with MIN and MAX indicates the minimum and maximum measured value shown in the combo display above the measured value.

If the MIN and MAX extension is used on text parameters, strings and query only commands which do not retrieve measured values a timeout occurs, followed by an error message in the error queue.

1. Numeric parameter

Example:	**Response:**
:OUTPut: SAMPle:FREQuency?	48 KHZ
:OUTPut: SAMPle:FREQuency? MIN	30 KHZ
:OUTPut: SAMPle:FREQuency? MAX	200 KHZ

2. Measurement Results

Example:	Response:
:SENSe:DATA? :SENSe:DATA? MIN :SENSe:DATA? MAX 	-82.341 DBFS -101.695 DBFS -19.979 DBFS

3. Strings are returned in single quotation marks.
   Extension with MIN AND MAX is not permissible.

Example:	Response:
:MMEMory:SWEep:STORe?	'MYTRACE.TRC'

4. Text parameters (character data) are returned in short form.
   Extension with MIN AND MAX is not permissible.

Example:	Response:
:SENSe:FUNCtion?	RMS

6.5.3 Parameter

Most commands require the entry of a parameter. Parameters must be separated from the header by a "white space". Parameters may be numeric values, Boolean parameters, text, character strings or block data. The type of parameter required for the particular command is stated in the details of the command.

Numeric values	Numeric values may be entered in any customary form, i.e. with sign, decimal point and exponent. The range of values is -9.9E37 to 9.9E37. The exponent is denoted by "E" or "e". The exponent alone must not be used.
Numeric strings	The format specified under "Numeric values" also applies to the individual values of a numeric string. Numeric values are to be separated from each other by means of a comma. Numeric strings are not entered between quotation marks. **Example:** `TRACe:SWEep:STORe:AY 0.1,0.2,0.3,0.4,0.5`
Units	Physical quantities may be stated with the unit. Permissible unit prefixes are K (kilo), M (milli) and U (micro). The SCPI command determines which unit prefixes are permissible. If the unit is not specified, then the base unit is used. **Example:** `SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3`

Text parameter	Text parameters follow the syntax rules for keywords, i.e. they also have a long and a short form. They must be separated from the header by a "white space" like any other parameter. A query returns either the long or short form of the text parameter depending on the setting "Longform" in the Config panel. If a text parameter is set which is already set in the data basis of the audio analyzer the internal R&S UPP the internal setting routine is not performed. This behavior increases the speed of the IEC bus control program. **Example:** Setting command: `:SOURce:SWEep:CONTrol ASWeep` Query: `:SOURce:SWEep:CONTrol?` Response: `ASW` or `ASWeep`
Strings	Character strings must always be entered between single or double quotation marks. Filenames also count as strings. Normally, however, single quotation marks are used, as double quotation marks are used to mark the complete IEC bus command as a string. String commands can be written via IEC bus command, even if the respective setting line is not visible in the panel. **Example:** `MMEMory:LOAD:STATe 'c:\Config\setup\default.xml'`
Block data	The '#' character identifies the start of a block data record which is defined as follows: #<LengthOfLength><Length><Binary data record> <LengthOfLength> specifies how many characters the following length specification has. <Length> indicates the number of following bytes of the binary data record. The length information consists of ASCII characters. If, for example, the <Length> of a binary data block is 35, this involves ASCII character '3' and '5' with the binary equivalents 00110011 and 00110101 or the hexadecimal equivalents 0x33 and 0x35. <Binary data record> designates the binary data record with the specified length. **Example:** `MMEMory:LOAD:STATe 'c:\Config\setup\default.xml'`

6.5.4 Overview of Syntax Elements

The following list gives you an overview of the syntax elements.

:	The colon separates the keywords of a command. In a command line, the colon following a semicolon identifies the highest command level.
;	The semicolon separates two commands in a command line. It does not change the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk identifies a common command.
"	Quotation marks denote the beginning of a character string and terminate it.
#	The double cross denotes the beginning of block data.
	A "white space" (ASCII code 0 to 9, 11 to 32 decimal, eg space) separates header and parameter.
.	Decimal point of numeric values.

6.6 Device Model and Command Processing

The device model shown in the following figure was created from the point of view of processing SCPI commands. The individual components operate independently of each other and simultaneously. They communicate with each other by means of messages.

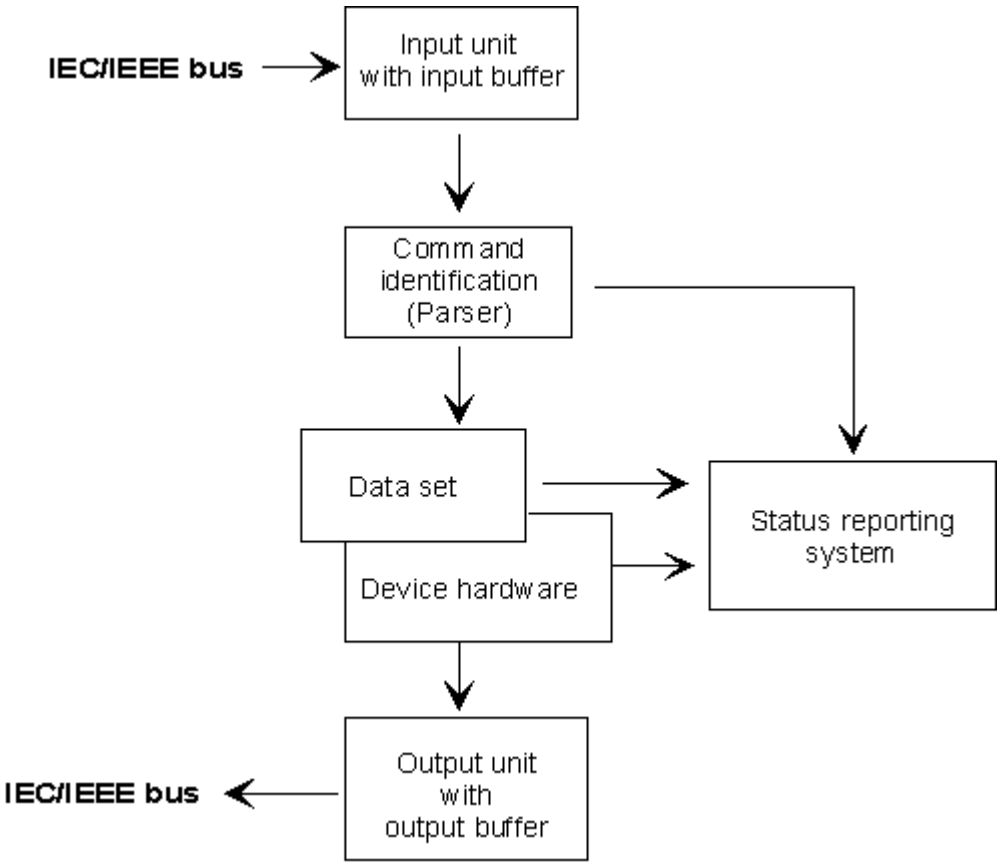


Fig. 6-2: Device model for remote control via IEC/IEEE bus or TCP/IP network

6.6.1 Input Unit

The input unit receives commands in the form of characters from the IEC/IEEE bus or Ethernet and collects them in the input buffer. The input unit sends a message to the command recognition as soon as it detects an end character according to IEEE 488.2 (new line = ASCII code 10 decimal or EOI line becomes active), the interface message DCL or a full input buffer. If the input buffer is full, the IEC/IEEE bus or Ethernet transfer is halted and the data received until then are processed. Then the IEC/IEEE bus or Ethernet transfer is continued. If the buffer is not yet full when the end character is received however, the input unit can receive the next command while the previous command is parsed and executed. Reception of a DCL clears the input buffer and immediately triggers a message to the parser.

6.6.2 Parser Analyzes

The parser analyzes the data received from the input unit. Data are processed in the sequence in which they were received. Only a DCL is given priority; a GET (Group Execute Trigger) for example is not processed until after the previously received commands. Every command detected as correct is immediately forwarded to the database and executed.

Syntax errors are recognized by the parser and forwarded to the status reporting system. The remainder of a program message after a syntax error is, in as much as possible, further analyzed and processed. After the syntax test, the value range of the parameter may be checked.

6.6.3 Database and Device Hardware

The term "device hardware" refers to that part of the device which performs the actual instrument function, e.g. generator setting, analyzer setting. This does not include the controller.

The term "database" denotes a database that manages all the parameters and associated settings required for setting the device hardware.

Setting commands lead to a change in the data set of the database. The database administration enters the new values (e.g. frequency) and immediately sets the hardware.

An IEC/IEEE bus program message that may contain several setting commands is sent to the parser, which examines the IEC/IEEE bus commands for syntax and semantic errors. Once a command is identified as correct, a check is immediately made with current settings to see whether the command is admissible. If the command is admissible, it is transferred to the database of the R&S UPP and the device hardware is set. If existing settings show that the command is illegal, it is rejected, an execution error is sent to the status reporting system and the device hardware is not set for this command. Subsequent commands that are admissible on the basis of the existing settings are executed (see following section). This strictly hierarchic procedure ensures that no illegal device status can occur at any time.

6.6.4 Command Sequence (IEC/IEEE)

Every IEC/IEEE bus command received by the R&S UPP is immediately checked for its admissibility. This is only possible if the R&S UPPknows for which instrument or function the command is intended, i.e. the appropriate instrument or function was activated before.

Example:

- If a trigger channel is to be set in the multi channel analyzer, several start conditions are available which are not available for "Trigger Chan" = Off.
- If these checks and the appropriate error messages were omitted, measurements would be performed with erroneous settings, or even be impossible, and the user would not know why.

Identical menu items in different instruments or functions are addressed by the same command in remote control, so they can only be distinguished by reference to the particular instrument or function.

Example:

- The command `INPut:CHANnel CH1` is permitted for all two-channel analyzer tools.

- To be able to preset individual parameters of functions that are not yet active, each IEC/IEEE bus command would have to be told to which instrument and which function it refers. The internally managed addressing of commands by the R&S UPP would then be the job of the IEC/IEEE bus programmer, who would have to handle a multiple number of commands.

A major feature in operation of the R&S UPP is its ability to note the settings for individual generator and analyzer functions and to restore all required parameters when one of these functions is selected. This does away with the need to reset all parameters when a function is changed.

Example:

- The generator function "Mod Dist" is set with frequencies of 400 Hz and 7 kHz. When you switch to the DFD function, the frequency pair 11 kHz and 12 kHz last used with the DFD function is automatically restored.
- This functionality is also available under IEC/IEE bus control, i.e. even in remote control all parameters are automatically set when the function is changed. This is much faster and surer than the user having to set the parameters each time on the IEC/IEEE bus.
- If the R&S UPP did not have this ability, the user could overwrite parameters for instruments that are not active, and the parameters of the function last used would no longer be available.

Since manual and remote control work with the same internal data sets and a mixture of manual and remote control must be possible, only one uniform method of internal parameter processing can be used for the two modes. Automatic parameter restoration is indispensable for manual control, so it must also be used for remote control.

To relieve the user of the need to watch out for relationships that are in part not apparent, the following applies to both remote control and manual control of the R&S UPP:

Nothing can be set on the R&S UPP that is not admissible.

The disadvantage of this is that sometimes a certain operating sequence has to be adhered to even in remote control. But this is more than compensated by the fact that possible setting errors are immediately indicated by the instrument.

6.6.5 Status Reporting System

The status reporting system collects information about the device status and makes it available to the output unit on request. The structure and function are explained in section chapter 6.8, "Status Reporting System", on page 634.

6.6.6 Output Unit

The output unit collects the information requested by the controller and which it obtains from database administration. It processes the information in line with SCPI rules and makes it available in the output buffer.

If the device is addressed as a talker and the output buffer does not contain any data or expect data from the database, the output unit sends the error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC/IEEE bus or Ethernet, and the controller waits for the set time limit. This procedure is prescribed by SCPI.

6.6.7 Triggering Measurement or Sweep

There are three ways of triggering a measurement or a sweep :

- * By the SCPI-specific command `INIT`
- * By the common command `*TRG`
- * With the addressed command **G**roup **E**xecute **T**rigger `GET`

All three possibilities are equivalent and similar in the time they take to execute.

There are also three ways of waiting for a triggered measurement result, which are looked at in the next section. To demonstrate the three trigger possibilities together with singly triggered measurement results, command synchronization with *WAI is used in what follows.

6.6.8 Command Synchronization

To ensure that commands are executed in a certain sequence, one of the commands *OPC, *OPC? or *WAI must be used. As a result of these commands, a certain action is not triggered until the hardware is set and settled. The controller can be forced through appropriate programming to wait for the appearance of an action.

Table 6-1: Synchronization with *OPC, *OPC? and *WAI

Command	Effect	Programming of controller
*OPC	Sets the Operation Complete bit in the ESR after processing all commands sent before *OPC.	- Set bit 0 in ESE - Set bit 5 in STB - Wait for Service Request
*OPC?	Stops further command processing until 1 is returned. This is not the case until the Operation Complete bit is set in the ESR. This bit indicates that the previous setting has been completed.	Send *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Send *WAI directly after the command whose processing should be terminated before other commands are executed.

In remote control of the R&S UPP it is essential to wait for the end of a measurement or sweep before the measured results are fetched and the hardware is newly set.

The following table explains the effect of different combinations of measurement or sweep triggering in conjunction with a synchronization command.

Table 6-2: Trigger command with/without synchronization

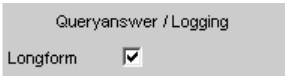
Trigger command with/without synchronization	**Description**
INIT:CONT OFF;*WAI	A single measurement or sweep is triggered. Subsequent commands are processed after the measurement or sweep is completed. Generator and analyzer setting commands do not trigger a new measurement. A new measurement must be triggered with INIT;*WAI . This command is the simplest to use and should preferably be used to trigger a measurement.
"INIT:CONT ON;*WAI"	A continuous measurement or continuous sweep will be triggered. Subsequent commands will not be processed until the first measurement or the first sweep cycle has been completed. Generator and analyzer configuration commands immediately trigger a restart of the continuous measurement.
"INIT:CONT OFF" without *WAI	When a generator or analyzer setting command is sent during a single measurement, i.e. before the measurement is completed, the measurement is restarted to avoid incorrect results (incorrect results could be obtained, for instance, if the generator voltage is varied during the measurement). Generator or analyzer setting commands sent after the single measurement has been terminated will not trigger a new measurement. A new measurement must be triggered with "INIT".
"INIT:CONT ON" without *WAI	Each generator or analyzer setting command restarts a measurement to avoid incorrect measurement results (incorrect results could be obtained, for instance, if the generator voltage is varied during the measurement).

6.7 Command Recording

The R&S UPP offers the possibility of recording the equivalent IEC/IEEE bus commands in a separate window during manual control. The recording runs as long as the window is open. The contents of the window can be edited (also deleted) and copied to the clipboard.

In this way it is very easy to produce the matching IEC/IEEE bus control program from a manual control sequence without having to look up the commands in the manual. This also eliminates malfunctions through the wrong notation.

From the Config Panel (Menu * Utilities * Config Panel), you can select whether to use the short or long form of the command parameters when recording commands or querying parameters (Query).



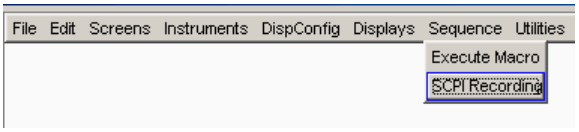
Remote-control command:

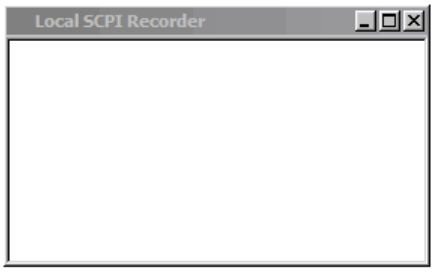
`SYSTem:QLONg ON | OFF`

Example: If the analog generator has been set to "Output Type" = Bal, the query `OUTPut:TYPE?` returns `BAL` in the short form and `BALanced` in the long form.

6.7.1 Starting Recording

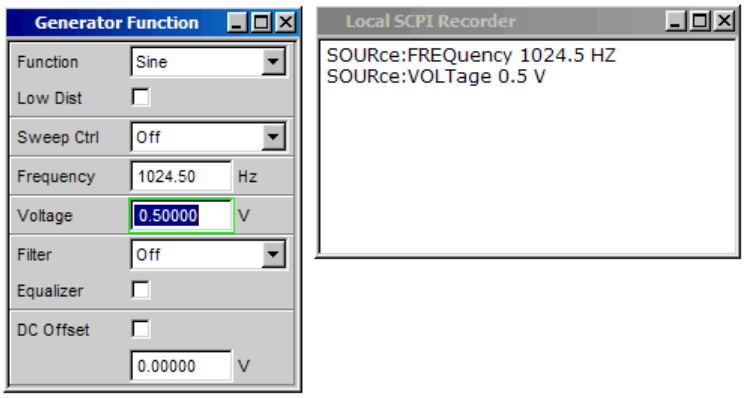
Open the window through the "Menu" by "Sequence" * "SCPI Recording"





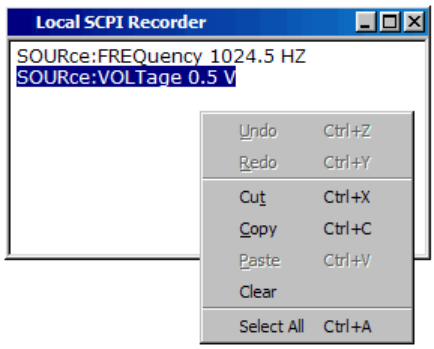
6.7.2 Recording Commands

As long as the SCPI Recording window is opened, almost all settings of manual control are recorded. Exceptions are a few setting commands that affect the graphical representations and whose setting is generally not required via remote control. In this example, the generator frequency was set to 1024.5 Hz and the level to 0.5 V.



6.7.3 Editing Commands

The contents of the SCPI Recording window can be edited and copied through the clipboard into a file. From the commands in this file it is possible to generate an IEC/IEEE bus control program. Open the context menu by clicking on the right mouse key. To operate the SCPI Recorder you need an external keyboard and mouse.



6.8 Status Reporting System

The status reporting system stores all information about the current operating status of the device, (e.g. that it is currently performing a hard copy) and about errors that occurred. This information is stored in the status registers and the error queue. The contents of status registers and the error queue can be queried on the IEC/IEEE bus or via the LAN or USB interface.

Information is hierarchically structured. The highest level is formed by the Status Byte (STB) register defined in IEEE 488.2 and the associated Service Request Enable (SRE) register.

The STB obtains its information from the standard Event Status Register (ESR) also defined in IEEE 488.2 with the associated enable register standard Event Status Enable (ESE) and the registers defined by SCPI, `STATus:OPERation` and `STATus:QUEStionable` and the instrument-specific registers `STATus:XQUEStionable`, `STATus:QUEStionable:UNDERrange`,

STATus:QUEStionable:OVERrange and STATus:QUEStionable:MEASuring, which contain more detailed information about the instrument.

The status reporting system also includes the IST (Individual STatus) flag and the Parallel Poll Enable (PPE) register assigned to it. The IST flag, like the SRQ, combines the complete device status in a single bit. The PPE has the same function for the IST flag as the SRE has for the service request.

The output buffer contains messages that the device sends back to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB.

6.8.1 Structure of SCPI Status Register

Each SCPI register consists of five 16 bit parts with different functions (see figure below). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number that is the same for all five parts. For instance, bit 5 of the STATus:OPERation register is assigned to the Wait for Trigger hardware status in all five parts.

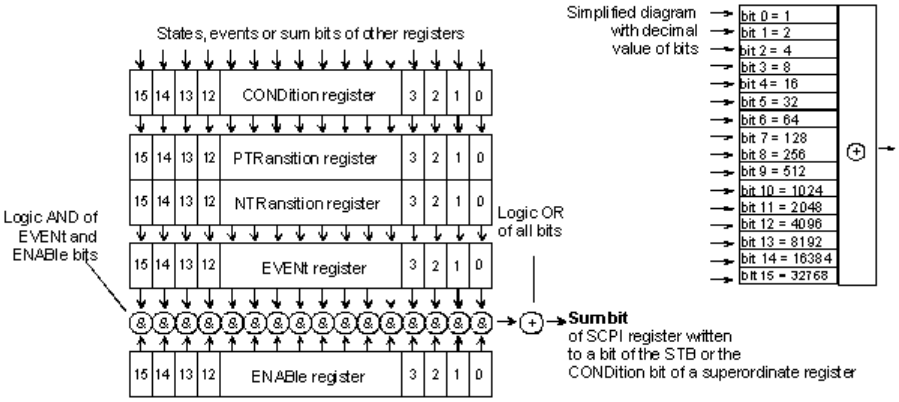

States, events or sum bits of other registers
CONDition register
PTRansition register
NTRansition register
EVENt register
ENABle register
Logic AND of EVENt and ENABle bits
Logic OR of all bits
Simplified diagram with decimal value of bits
bit 0 = 1
bit 1 = 2
bit 2 = 4
bit 3 = 8
bit 4 = 16
bit 5 = 32
bit 6 = 64
bit 7 = 128
bit 8 = 256
bit 9 = 512
bit 10 = 1024
bit 11 = 2048
bit 12 = 4096
bit 13 = 8192
bit 14 = 16384
bit 15 = 32768
Sum bit
of SCPI register written to a bit of the STB or the CONDition bit of a superordinate register

Fig. 6-3: General structure of the status registers

Queries return the current value of the particular part register to allow a check of the device status. A decimal value between 0 and 32767 (= 2^15 − 1), or between 0 and 65535 (= 2^16 − 1), is returned.

The configuration commands set the respective part register, thus determining which status changes of the R&S UPP cause a change in the status registers. A decimal value between 0 and 32767 (= 2^15 − 1), or between 0 and 65535 (= 2^16 − 1), is set.

- **CONDition**
  The CONDition part is written directly by the hardware or the summary bit of the subordinate register. Its contents indicate current device status. This register part can only be read, not written or cleared. Reading the register does not change its contents.
- **PTRansition**
  These two transition register parts enable you to define the status change of the CONDition part (none, 0 to 1, 1 to 0 or both) that is to be held in the EVENt part.

The Positive-TRansition part acts as an transition filter. On transition of a bit of the CONDition part from 0 to 1, the associated PTR bit, decides whether the EVENt bit is set to 1.
– PTR bit =1: the EVENt bit is set.
– PTR bit = 0: the EVENt bit is not set.

This part can be written and read. Reading does not change its contents.

- **NTRansition**
  The Negative-TRansition part also works as a transition filter. On transition of a bit of the CONDition part from 1 to 0, the associated NTR bit, decides whether the EVENt is set to 1.
  – NTR bit =1: the EVENt bit is set.
  – NTR bit = 0: the EVENt bit is not set.

  This part can be written and read. Reading does not change its contents.
- **EVENt**
  The EVENt part indicates whether an event has taken place since the last read out. It is the memory of the CONDition part. It only indicates events passed through the transition filters. The EVENt part is continuously updated by the device. This part is read-only. Reading clears its contents. This part is often equated with the overall register.
- **ENABle**
  The ENABle determines whether the associated EVENt bit contributes to the total bit (see below). Each bit of the EVENt part is ANDed to the corresponding ENABle bit ('&' symbol). The results of all logical operations of this part are ORed (symbol '+') and passed on to the summary bit.
  ENABle Bit = 0: the associated EVENt bit does not contribute to the total bit
  ENABle Bit = 1: if the associated EVENt bit is 1, the total bit is likewise set to 1.
  This part can be written and read as required. Reading does not change its contents.

Summary bit

As stated above, the summary bit for each register is derived from the EVENt and ENABle parts. The result is then entered in a bit of the CONDition part of the higher-level register. The device automatically generates the summary bit for each register. This enables an event, e.g. an overrange, to lead to a service request through all hierarchy levels.

6.8.2 Overview of Status Registers

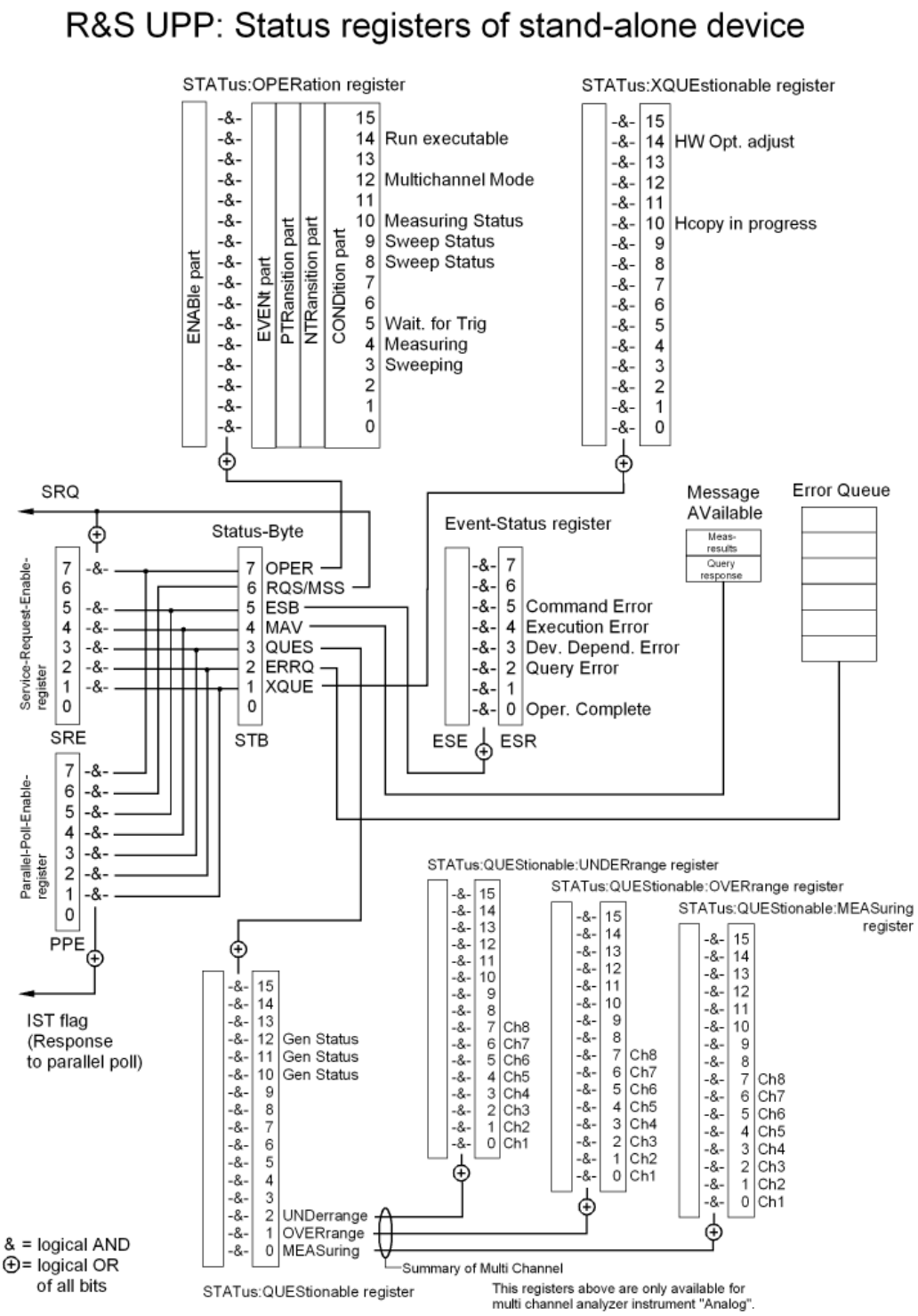


Fig. 6-4: Overview of Status Registers

The changes for the status registers for the cascading operating mode are minor, see also chapter 8.7.3.4, "Cascading and Status Reporting System", on page 829.

6.8.3 Status Byte (STB) and Service Request Enable (SRE) Register

The STB is already defined in IEEE 488.2. It gives a rough overview of the device status, collecting information from the lower-level registers. So it is comparable with the CONDition part of an SCPI register and is at the highest level of the SCPI hierarchy. It is special in that bit 6 acts as the summary bit of all other bits of the status byte.

Reading the STB does **not** delete its content!

The status byte is read out with the `*STB?` or a Serial Poll.

Associated with the STB is the SRE. The function of the SRE corresponds to that of the `ENABle` part of the SCPI registers. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) will be generated on the IEC/IEEE bus or Ethernet, which triggers an interrupt in the controller configured for this purpose, and can be further processed by the controller.

The SRE can be set with the `*SRE` command and read out with `*SRE?`.

Reading the `EVENt` deletes the associated bit in the status byte register (e.g. `STAT:OPER:EVEN?` deletes the OPER bit (d7) in the OPERation register).

Table 6-3: Meaning of bits in status byte

Bit no.	Meaning
7	**OPERation status register summary bit** This bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the device is executing an action. The type of action can be determined by querying the OPERation status register with STATus:OPERation:CONDition? or STATus:OPERation[:EVENt]? .
6	**MSS bit (master status summary bit)** This bit is set if the device triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register.
5	**ESB bit** Summary bit of the event status register. This bit is set if one of the bits in the event status register is set and enabled in the event status enable register. A set bit indicates an error or event that can be specified more precisely by querying the event status register by the command "*ESR?" .
4	**MAV bit (message available)** This bit is set if there is a readable message is in the output buffer. A measurement result or response to a query (i.e. IEC/IEEE bus command with '?') is present and can be read.
3	**QUEStionable status summary bit** This bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABLe bit is set to 1. A set bit denotes a questionable device status, which can be specified more precisely by querying the QUEStionable status register with STATus:QUEStionable:CONDition? or STATus:QUEStionable[:EVENt]? .

Bit no.	Meaning
2	**Error queue not empty** The bit is set if the error queue has an entry. This can be fetched by the command SYSTem:ERRor? . If this bit is enabled by the SRE, each entry of the error queue will generate a service request. An error can thus be recognized and specified in more precisely by querying the error queue.
1	**XQUEstionable status summary bit** This bit is set if an EVENt bit is set in the XQUEStionable status register and the associated ENABLe bit is set to 1. The register can be read by the queries STATus:XQUEstionable:CONDition? or STATus:XQUEstionable[:EVENt]?.
0	**Not used**

6.8.4 IST Flag and Parallel Poll Enable (PPE) Register

Similar to the SRQ, the IST flag combines the complete status information in a single bit. It can be queried by a parallel poll, see chapter 6.8.12.3, "Parallel Poll", on page 649.

The parallel poll enable (PPE) register determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, bit 6 also being used - in contrast to the SRE. The IST flag is the product of ORing all results. The PPE can be set by the *PRE command and read by the *PRE? query.

6.8.5 STATus:EVENt Register (ESR)

The ESR is already defined in the IEEE 488.2 standard. It is comparable to the EVENt part of an SCPI register. The event status register can be read out by the *ESR? query.

Reading the ESR deletes its content!

The ESE can be understood as the ENABle part. It can be set by the *ESE command and read out by the *ESE? query

Table 6-4: Meaning of bits in event status register

Bit no.	Meaning
7	**Not used**
6	**User request** This bit is set with CTRL+F11 or upon closing the remote window with the mouse, i.e. when the instrument is switched to manual operation.
5	**Command error** This bit is set if an undefined command or a command with incorrect syntax is received. An error message describing the error more precisely is entered in the error queue.

Bit no.	Meaning
4	**Execution error** This bit is set if the syntax of a received command is correct but the command cannot be executed due to various marginal conditions. An error message describing the error more precisely is entered in the error queue.
3	**Device-dependent error** This bit is set if a device-dependent error occurs. An error message describing the error more precisely is entered in the error queue.
2	**Query error** This bit is set in either of the two following cases: the controller wants to read data from the device but has not sent a query, or it sends new commands to the device before it retrieves existing requested data.
1	**Not used**
0	**Operation complete** When the *OPC command is received, this bit is set if all previous commands have been executed.

6.8.6 STATus:OPERation Register

The CONDition register contains information on the operations currently being performed by the device, while the EVENt register contains information on the operations performed by the device since the last readout of the register. It can be read by the query `STATus:OPERation:CONDition?` or `STATus:OPERation[:EVENt]?`.

Reading the EVENt part deletes its content!

Table 6-5: Meaning of bits in STATus:OPERation register

Bit no.	Meaning	
15	**Not used**	
14	**Run executable** If an executable program (*.exe) is started manually or by means of the SYSTem:PROGramm:EXECute 'filename' command, this bit is set to 1; when the program is completed, this bit is reset to 0. The change from 1/ 0 can be checked by means of a Serial poll and Parallel poll, or it can trigger an SRQ in order to fetch measurement data, for example.	
13	**Not used**	
12	**Multichannel mode** 0 = Two-channel operation 1 = Multichannel operation	
11	**Not used**	
10	**Measuring status** Together with bit 4, this bit results in the following statuses: Bit 4, 10	
	0 0 = Measuring Terminated	Single measurement completed
	0 1 = Measuring Stopped	Measurement has been stopped

Bit no.	Meaning	
	1 0 = Measuring Single	Single measurement in progress
	1 1 = Measuring Cont	Continuous measurement is being performed
8 and 9	**Sweep status** Together with bit 3, this bit results in the following statuses: Bit 3, 9, 8	
	0 0 0 = Sweep Off	No sweep is being performed
	0 0 1 = Not used	
	0 1 0 = Sweep Stopped	Sweep was halted and can be continued
	0 1 1 = Sweep Waiting	Sweep is waiting to (re)start
	1 0 0 = Sweep Run Manual	Manual sweep is being performed
	1 0 1 = Sweep Run Single	Single sweep is being performed
	1 1 0 = Sweep Run Cont	Continuous sweep is being performed
	1 1 1 = Not used	
7	**Not used**	
6	**Not used**	
5	**Waiting for trigger** This bit is set as long as the R&S UPP is waiting for a trigger event. Example: The generator outputs a sine burst signal with a "Burst on Delay" of 2 s. As trigger condition for the analyzer, a "Lev Trig" is set under "Start Cond". For a period of 2 s, i.e. as long as the trigger condition is not met, this bit is set. Once the trigger event occurs, this bit is reset.	
4	**Measuring** This bit is set while the R&S UPP is performing a measurement. Bit 10 indicates the measuring status. Together with bit 10, this results in the following statuses: Bit 4, 10	
	0 0 = Measuring Terminated	Single measurement completed
	0 1 = Measuring Stopped	Measurement has been stopped
	1 0 = Measuring Single	Single measurement in progress
	1 1 = Measuring Cont	Continuous measurement is being performed
	Bits 0 and 1 in the STATus:XQUEstionable register indicate which channel this information refers to:	
	0	Measuring Ch1 (bit 0)
	0	Measuring Ch2 (bit 1)
	0 0	= Not used
	0 1	= The information refers only to channel 2
	1 0	= The information refers only to channel 1

Bit no.	Meaning	
	1 1	= The information refers to both channels
3	**Sweeping** This bit is set while the R&S UPP is performing a sweep. Bits 8 and 9 indicate the sweep status.	
2	Not used	
1	Not used	
0	Not used	

6.8.7 STATus:QUEStionable Register

This register contains information about questionable device statuses. These may occur when the device is operated beyond its specifications. It can be read by the queries `STATus:QUEStionable:CONDition?` or `STATus:QUEStionable[:EVENt]?`

Reading the EVENt part deletes its content!

Bit no.	Meaning	
15	**Not used**	
14	**Not used**	
13	**Not used**	
12 11 10	Generator status Bit 12, 11, 10 0 0 0 = Not used 0 0 1 = Generator Off 0 1 0 = Generator Running 0 1 1 = Not used 1 0 0 = Generator Halted 1 0 1 = Not used 1 1 0 = Generator Overload 1 1 1 = Output Off	 Both generator channels are off Generator outputs signal Generator outputs zero level Generator overloaded, output disabled Output disabled
9	**Not used**	
8	**Not used**	
7	**Not used**	
6	**Not used**	
5	**Not used**	
4	**Not used**	

Bit no.	Meaning
3	**Not used**
2	**Summary of multichannel UNDerrange** for multichannel operation Summary bit for the lower-order STATus:QUEStionable:UNDERrange register, which makes the underrange information for the individual channels available during multichannel operation.
1	**Summary of multichannel OVERerrange** for multichannel operation Summary bit for the lower-order STATus:QUEStionable:OVERrange register, which makes the overrange information for the individual channels available during multichannel operation.
0	Summary of multichannel MEASuring for multichannel operation Summary bit for the lower-order STATus:QUEStionable:MEASuring register, which returns the activated channels during multichannel operation.

6.8.8 STATus:QUEStionable:UNDERrange Register

This register only contains underrange information concerning the individual channels of multichannel operation. It can be read by the query

`STATus:QUEStionable:UNDERrange:CONDition?`or

`STATus:QUEStionable:UNDERrange[:EVENt]?`

.

Reading the EVENt part deletes its content!

Table 6-6: Meaning of bits in STATus:QUEStionable:UNDERrange register

Bit No.	Meaning	
15	**Slave 8**	For cascading, signals with a '1' which slave has identified an underrange.
14	**Slave 7**	
13	**Slave 6**	
12	**Slave 5**	
11	**Slave 4**	
10	**Slave 3**	
9	**Slave 2**	
8	**Slave 1**	
7	**Ch8**	0 = The channel in question is not underranged. 1 = The channel in question is underranged; the measurement result is inaccurate and no longer in line with the specifications of the R&S UPP. The associated summary bit is in the `STATus:QUEStionable` register bit 2
6	**Ch7**	
5	**Ch6**	
4	**Ch5**	
3	**Ch4**	

Bit No.	Meaning	
2	**Ch3**	
1	**Ch2**	
0	**Ch1**	

6.8.9 STATus:QUEStionable:OVERrange Register

This register only contains overrange information concerning the individual channels of multichannel operation. It can be read by the query

`STATus:QUEStionable:OVERrange:CONDition?`or

`STATus:QUEStionable:OVERrange[:EVENt]?`

.

Reading the EVENt part deletes its content!

Table 6-7: Meaning of bits in STATus:QUEStionable:OVERrange register

Bit No.	Meaning	
15	**Slave 8**	For cascading, signals with a '1' which slave has identified an overrange.
14	**Slave 7**	
13	**Slave 6**	
12	**Slave 5**	
11	**Slave 4**	
10	**Slave 3**	
9	**Slave 2**	
8	**Slave 1**	
7	**Ch8**	0 = The channel in question is not overranged. 1 = The channel in question is overranged. If the measurement result of an overranged channel is requested with the SENSx:DATAy? command, the value "3.40282346639e+038" (represents NaN = Not a Number) is returned. The associated summary bit is in the `STATus:QUEStionable` register bit 1
6	**Ch7**	
5	**Ch6**	
4	**Ch5**	
3	**Ch4**	
2	**Ch3**	
1	**Ch2**	
0	**Ch1**	

6.8.10 STATus:QUEStionable:MEASuring Register

This register only contains information which channels are switched on or off for multichannel operation. It can be read by the query

STATus:QUEStionable:MEASuring:CONDition?or

STATus:QUEStionable:MEASuring[:EVENt]?

.

Reading the EVENt part deletes its content!

Table 6-8: STATus:QUEStionable:MEASuring Register

Bit No.	Meaning	
15	**Slave 8**	For cascading, signals with a '1' which slave has identified a change of the channel setting.
14	**Slave 7**	
13	**Slave 6**	
12	**Slave 5**	
11	**Slave 4**	
10	**Slave 3**	
9	**Slave 2**	
8	**Slave 1**	
7	**Ch8**	Returns the setting of channels of multichannel operation in the Analyzer Config panel. 0 = The channel in question is deactivated 1 = The channel in question is activated The associated summary bit is in the STATus:QUEStionable register bit 0
6	**Ch7**	
5	**Ch6**	
4	**Ch5**	
3	**Ch4**	
2	**Ch3**	
1	**Ch2**	
0	**Ch1**	

If a two-channel analyzer is switched on, the bits 0 ... 15 are deleted.

6.8.11 STATus:XQUEstionable Register

This register contains extra information to the status operation register and seldom occurring status information. It can be read by the query

STATus:XQUEStionable:CONDition?or

STATus:XQUEStionable[:EVENt]?

Reading the EVENt part deletes its content!

Bit no.	Meaning
15	**Not used**
14	**HW option adjust**
13	**Not used**
12	**Not used**
11	**Not used**
10	**Hard copy in progress**
9	**Not used**
8	**Not used**
7	**Not used**
6	**Not used**
5	**Not used**
4	**Not used**
3	**Not used**
2	**Not used**
1	**Not used**
0	**Not used**

If a multichannel analyzer is switched on, the bits 0 ... 5 are deleted.

6.8.12 Use of Status Reporting System

For efficient use of the status reporting system, the information it contains has to be transferred to the controller and further processed. There are various methods, which are described below.

6.8.12.1 Service Request, Use of Hierarchical Structure

Under certain conditions the device may send a service request to the controller. This service request usually triggers an interrupt on the controller to which the control program can respond by suitable actions. As seen in section chapter 6.8.2, "Overview of Status Registers", on page 637, an SRQ is always triggered when one or more of the bits 1, 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information from another register, from the error queue or the output buffer. If the ENABle registers of the status registers are set accordingly, any bit in any status register will be able to trigger an SRQ.

Example:

Use the `*OPC` command to generate an SRQ.

`CALL IBWRT(analyzer%, "*ESE 1")` to set the bit 0 in the ESE (Operation Complete)

`CALL IBWRT(analyzer%, "*SRE 32")` to set the bit 5 in the SRE (ESB)

The device generates an SRQ on completion of its settings.

The SRQ is the only way for the device to become active on its own. Each controller program should set the device such that a service request is triggered in case of malfunctions. The program should respond accordingly to the service request.

6.8.12.2 Serial Poll

Serial poll is mainly used for a fast overview of the status of several devices connected to the IEC/IEEE bus or LAN/USB.

Like the *STB? command, the serial poll is used to query the status byte of a device. Querying is implemented by interface messages, however, making it much faster. The serial poll method is already defined in the IEEE 488.1 standard, and used to be the only uniform method of querying the status byte. This method also works with devices that conform neither to SCPI nor to IEEE 488.2.

The VISUAL BASIC command for executing a serial poll is `IBRSP`.

A prerequisite for programming in VISUAL BASIC are that the project contains the modules NIGLOBAL (Niglobal.bas) and VBIB32 (Vbib_32.bas), and the gpibNotify OLE control module .

Example:

Program:

```
Public UPV As Integer
Public Info As Integer
Dim StartT As Single
Dim Response As String * 1000

Private Sub ReadESR():                                  'subroutine for readout of ESR
Call ibwrt(UPV, "*ESR?")                                'ask for ESR data
Call ibrd(UPV, Response)                                'read ESR data
EventList.AddItem "ESR register is: " + Left(Response, ibcntl - 1)
DoEvents
End Sub

'SRQ subroutine in case RQS was set
```

```
Private Sub GPIB_Notify(ByVal LocalUPV As Long, ByVal LocalIbsta As Long, ByVal LocalIberr As Long,
ByVal LocalIbcntl As Long, RearmMask As Long)
Call ibrsp(UPV, Info):                                  'do a serial poll and read STB
EventList.AddItem "SRQ " + " was fired after " + Trim(Str(Timer - StartT)) + " s"
EventList.AddItem "STB register is: " + Trim(Str(Info))
Call ReadESR
ibloc UPV                                               'switch UPV to local
ibonl UPV, 0                                            'switch interface offline
End Sub

Private Sub Test_Click():                               'main program
Call ibdev(0, 20, 0, T3s, 1, 0, UPV)                    'attach instrument
Call ibconfig(0, IbcAUTOPOLL, 1)                        'enable auto serial polling
Call ibconfig(0, IbcEndBitIsNormal, 1                   'set END bit on EOS match during read
Call ibconfig(0, IbcEOScmp, 0)                          "7 bit EOS char
Call ibconfig(0, IbcEOSrd, 1)                           'terminate read by EOS char
Call ibconfig(0, IbcEOSchar, 10)                        'EOS character LF as terminator
Call ibclr(UPV)                                         'device clear
Call ibwrt(UPV, "*IDN?")                                'ask for instrument identity
Call ibrd(UPV, Response)                                'read query result
EventList.AddItem Left(Response, ibcntl - 1)            'display query result as message box
DoEvents

Call ibwrt(UPV, "*CLS")                                 'reset registers
Call ibwrt(UPV, "*ESE 1")                               'enable operation complete bit to set ESB
Call ibwrt(UPV, "*SRE 32")                              'ESB bit generates SRQ
Call ReadESR                                            'reading clears ESR register

GPIB.SetupMask = RQS                                    'set notify mask to Service Request
GPIB.SetupNotify UPV                                    'call and enable notify function
EventList.AddItem "SRQ enabled ..."
DoEvents

EventList.AddItem "sending INIT command ..."
DoEvents
StartT = Timer
```

```
Call ibwrt(UPV, "INIT;*OPC")                    'trigger measurement, rise OPC when ready
EventList.AddItem "waiting for SRQ ..."
EventList.AddItem "-----------------------------------------------------"
DoEvents

'here the program could do anything else until a SRQ is set

End Sub
```

6.8.12.3 Parallel Poll

In the case of a parallel poll up to eight devices are simultaneously requested by a command from the controller to transmit one bit of information on the data lines, i.e. to set the data line assigned to each device to logic 0 or 1. Analogously to the SRE register, which determines the conditions for generating an SRQ, a parallel poll enable (PPE) register is present that is ANDed bit-by-bit with the STB (taking into account bit 6). The results are ORed and the result is then sent (possibly inverted) to the controller as a response to a parallel poll. The result can also be read without a parallel poll by the command *IST.

The device must first be set for parallel poll by the Visual Basic command IBPPC(). This command assigns the device a data line and specifies whether the response is to be inverted. The parallel poll itself is performed with IBRPP().

The parallel poll mode is mainly used to quickly find out which of the many devices connected to the IEC/IEEE bus or LAN/USB caused an SRQ. For this purpose, SRE and PPE must be set to the same value.

6.8.12.4 Queries

Each part of a status register can be read out by queries. The queries are given in the description of the status commands (STATus subsystem). The queries always yield a number representing the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are mainly used after the appearance of an SRQ to obtain more information about the cause of the SRQ.

6.8.12.5 Error Queue Query

Each error in the device causes an entry in the error queue. The entries in the error queue are detailed error messages in plain text that can be read out on the IEC/IEEE bus or LAN/USB by the query SYSTem:ERRor? . Each SYSTem:ERRor? query is answered by an entry from the error queue. If there are no more error messages in the error queue, the device responds with 0 = "No error".

The error queue should be queried in the controller program after each SRQ since the queue entries provide a more precise description of the error cause than the status registers. In particular, in the test phase of a controller program the error queue should be queried at regular intervals since it also registers faulty commands from the controller to the device.

6.8.13 Initializing the Status Reporting System

Commands `*RST`, `SYSTem:PRESet DCL` and `SDC` do not affect the status reporting system. Commands `*RST` and `SYSTem:PRESet` affect the instrument settings.

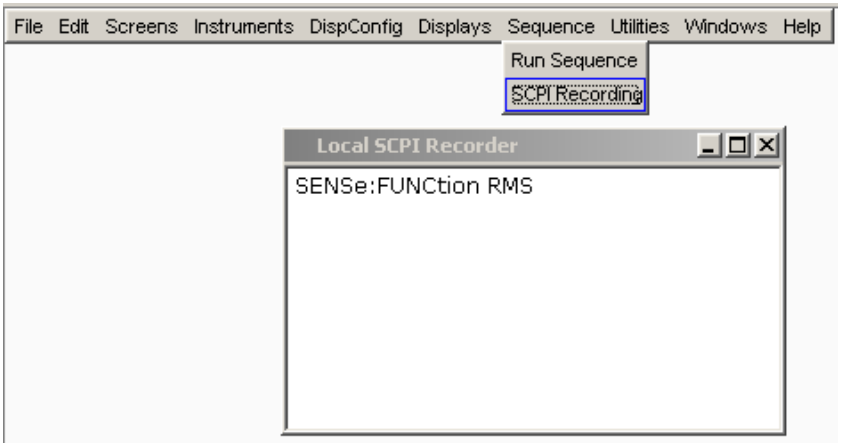
Table 6-9: Resetting device functions

Event	**DCL (Device Clear), SDC (Selected DeviceClear)**	***RST or SYSTem:PRESet**	**STATus:PRESet**	***CLS**
Effect				
Clear STB, ESR	–	–	–	yes
Clear SRE, ESE	–	–	–	–
Clear PPE	–	–	–	–
Clear EVENt parts of registers	–	–	–	yes
Delete ENABle parts of the OPERation and all QUESTionable registers	–	–	yes	–
Fill PTRansition parts of all registers with 1, delete NTRansition parts	–	–	yes	–
Clear error queue	–	–	–	yes
Clear output buffer	yes	1)	1)	1)
Clear command processing and input buffer	yes	–	–	–
Effect on the instrument setting	-	yes	–	–
1) = Any command that is the first in a program message clears the output buffer.				

7 Remote Control - Command Description

The description of each manual setting in chapter 5, "Instrument Function", on page 185 also shows the associated remote command. The meaning of the parameter setting fields and the effect of the individual parameters are explained in detail. A link to the command description including the parameters is provided for each setting. In most cases, the parameters shown in the panels can be unambiguously assigned to the parameters included in the remote control commands. For more complex selections or different names for manual and remote settings, the command is extended by a parameter description.

Moreover, the SCPI recording function (see chapter 6.7, "Command Recording", on page 632 offers a very convenient means of recording manual settings, thus allowing remote control commands to be assigned to the parameter fields in the panels. Since the panels do not provide for any settings relating to the triggering of measurements or reading of results, these functions are not recorded.



This chapter lists all commands. The sequence follows closly the sequence of the description of the manual settings in chapter 5, "Instrument Function", on page 185. In addition, the following commands are described:

- Commands that are not available during manual operation and thus cannot be recorded, such as common commands, triggering and output of measurement values
- Commands for using the system, mass memory and status system
- Commands that can only be carried out by using the softkey menu, and thus can also not be recorded.

An alphabetical list at the end of the user documentation offers an overview of all implemented commands.

In chapter 6, "Remote Control - Fundamentals", on page 609 you will find a general introduction to remote control as well as a description of the status registers.

7.1 Notation of Device-Specific Commands

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`INPut:COUPling AC` is equivalent to `INP:COUP AC`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `DATA:BARGraph:Y<ch>?`

Command: `DATA:BARG:Y2?`

This command reads out the Y axis value of channel 2.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `STATus:OPERation[:EVENt]?`

Command: `STAT:OPER:EVEN?` is equivalent to `STAT:OPER?`, the command reads out the content of the EVENt part of the STATus:OPERation register

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to chapter 6.5.3, "Parameter", on page 625..

Example:

Definition: `OUTPut:AUDiobits <audiobits>`

Command: `OUTP:AUD 24`

Special characters

|	A vertical bar in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used. **Example**: Definition: `OUTPut:TYPE <type> with parameter <type> = UNBalanced | BALanced` Command `OUTPut:TYPE BALanced` selects the balanced input Command `OUTPut:TYPE UNBalanced` selects the unbalanced input
[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. **Example**: `INSTrument[SELect] <inst> with parameter <inst> = ANLG | DIG` `INST:SEL ANLG` is equivalent to `INST ANLG` and selects the analog generator.

7.1.1 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

7.1.1.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SOUR:FREQ:REF 1500` = `SOUR:FREQ:REF 1.5E3`

7.1.1.2 Units

For physical quantities, the unit can be entered. Allowed units depend on the command used:

- k or K (kilo)
- m or M (milli)
- u or U (micro)

If the unit is missing, the basic unit is used.

Example:

`SENS:FREQ:REF 1.5kHz` = `SENS:FREQ:REF 1500`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

`DISPlay:SWEep:A:TOP 100PCT`

7.1.1.3 Special numeric values

The texts `MINimum` and `MAXimum` are interpreted as special numeric values. They denote the minimum and maximum value.

The numeric values associated to `MAXimum/MINimum` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark (see also chapter 6.5.2, "Responses to Queries", on page 624).

Example:

Setting command: `SOUR:VOLT MAX`

Query: `SOUR:VOLT? MAX`

Response: maximum numeric value

7.1.1.4 Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The character values are provided as the response for a query.

Example:

Setting command: `SENSe:FILTer:AWEighting ON or 1`

Query: `SENSe:FILTer:AWEighting?`

Response: `ON`

7.1.1.5 Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. Command `SYSTem:QLONg OFF | ON` determines if the short or long form is provided in the case of a query.

Example:

Setting command: `SENSe:THD:REJection NARRow`

Query: `SENS:THD:REJ?`

Response: `NARR` or `NARRow` depending on `SYSTem:QLONg` on page 809

7.1.1.6 Character strings

Strings must always be entered in quotation marks (' or ").

Example:

Definition: `MMEMory:LOAD:FREQuency <file>`

Setting command: `MMEMory:LOAD:FREQuency "Test1"` or

`MMEMory:LOAD:FREQuency 'Test1'`

7.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625–2) standard. Some commands have the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in chapter 6.8, "Status Reporting System", on page 634.

Available Common Commands

- `*CLS` on page 656
- `*CLS` on page 656
- `*ESE` on page 656
- `*ESR?` on page 656
- `*GTL?` on page 656
- `*IDN?` on page 656
- `*IST?` on page 657
- `*OPC` on page 657
- `*OPC?` on page 657
- `*PRE` on page 657
- `*PSC` on page 658

- *RST on page 658
- *SRE on page 658
- *STB? on page 658
- *TRG on page 658
- *WAI on page 659

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt part of all QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

In order to start a remote control program with a defined initial device status use command *RST or SYSTem:PRESet to preset the instrument. Then use command *CLS to clear the ESR Event status register e.g. in case of an aborted synchronization.

***ESE** <Value>

EVENT STATUS ENABLE sets the event status enable register to the value indicated. The query form *ESE? returns the contents of the event status enable register in decimal form.

Parameters:
<Value> 0 to 255

***ESR?** <Value>

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

Parameters:
<Value> 0 to 255

Usage: Query only

***GTL?**

Go To Local ends remote control and returns to manual control.

Usage: Query only

***IDN?**

IDENTIFICATION QUERY queries the instrument identification. The instrument type, order and serial number and the firmware version are returned.

Return values:

Example: Return values
Rohde&Schwarz, UPP-2, 1411.1003K04/10001, 2.1.60.0-2-3-0
Rohde&Schwarz, UPP = instrument type
1411.1003K04/10001 = part number/serial number
2.1.60.0 = firmware version
2.3.0 = R&S UPP version

Usage: Query only

***IST?** <StatusBit>

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll (see also chapter 6.8, "Status Reporting System", on page 634).

Parameters:
<StatusBit> 0 | 1

Usage: Query only

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register after all preceding commands have been executed. This bit can be used to initiate a service request (see also chapter 6.6, "Device Model and Command Processing", on page 627).

***OPC?**

OPERATION COMPLETE QUERY returns a 1 when all previous commands have been processed. It is important that the timeout set on the IEC/IEEE bus is sufficiently long.

***OPT?** <Options>

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas.

Usage: Query only

***PRE** <Value>

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the indicated value. The query form *PRE? returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value> 0 to 255

***PSC** <Function>

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers are preserved or reset during power-up.

The query form *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

Parameters:

<Function> 0 | 1

0
Causes the contents of the status registers to be preserved. Thus a service request can be generated when switching on the instrument, if the status registers ESE and SRE are suitably configured.

1
Resets the registers.

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing PRESET. This command clears the Enable and NTRansition parts of the Operation and Questionable registers and fills the PTRansition part with 1.

In order to start a remote control program with a defined initial device status use command `*RST` or `SYSTem:PRESet` to preset the instrument. Then use command `*CLS` to clear the ESR Event status register e.g. in case of an aborted synchronization.

***SRE** <Value>

SERVICE REQUEST ENABLE sets the service request enable register to the indicated value. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is generated. The query form `*SRE?` reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

Parameters:

<Value> 0 to 255

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

Usage: Query only

***TRG**

TRIGGER initiates a measurement or a sweep.

***WAI**

WAIT-to-CONTINUE permits servicing of subsequent commands only after all preceding commands have been executed and all signals have settled (see also chapter 6.6, "Device Model and Command Processing", on page 627).

7.3 Generator Settings

The generator settings commands are described in the following sequence:

1. Selecting the generator
2. Configuring the different types of generator
3. Setting the generator signal parameters
4. Special function: Rapid Deactivation of Outputs

7.3.1 Selecting the Generator

The generator type is selected with the `INSTrument` command.

INSTrument<n1> <generator_type>

This command selects the generator or analyzer. The active selection is determined by suffx <n1> at `INSTrument`.

Suffix:

<n1> 1 | 2
Suffix 1 (or no suffix) at `INSTrument` defines that selection of the generator is active.
Suffix 2 at `INSTrument` defines that selection of the analyzer is active, see chapter 7.4.1, "Selecting the Analyzer", on page 690.

Parameters:

<generator_type> ANLG | DIG | I2SBoard | | HDMI

ANLG
selects the analog generator

DIG
selects the digital generator

I2SBoard
selects the I^2S generator

HDMI
selects the HDMI generator

For analyzer parameters see chapter 7.4.1, "Selecting the Analyzer", on page 690.

Manual operation: See "Instrument" on page 185

7.3.2 Configuring the Generators

The generator settings are performed in the OUTPut and SOURce sub systems.

7.3.2.1 Reference Level and Frequency

Common generator commands concern the setting of the reference level and frequency. These settings are performed in the SOURce subsystem.

- SOURce:FREQuency:REFerence on page 660
- SOURce:VOLTage:REFerence on page 660

SOURce:FREQuency:REFerence <reference>

Parameters:
<reference> float

Manual operation: See "Ref Frequency" on page 189
See "Ref Frequency" on page 200
See "Ref Frequency" on page 207
See "Ref Frequency" on page 219

SOURce:VOLTage:REFerence <reference>

Parameters:
<reference> float

Manual operation: See "Ref Voltage" on page 189
See "Ref Voltage" on page 200
See "Ref Voltage" on page 207
See "Ref Voltage" on page 219

7.3.2.2 Configuring the Analog Generator

- OUTPut:BANDwidth:MODE on page 660
- OUTPut:CHANnel on page 661
- OUTPut:IMPedance on page 661
- OUTPut:TYPE on page 661
- SOURce:VOLTage:MAXimum on page 661
- SOURce:VOLTage:RANGe on page 661

OUTPut:BANDwidth:MODE <mode>

Parameters:
<mode> B22 | B40 | B80 | AUTO

Manual operation: See "Bandwidth" on page 188

OUTPut:CHANnel <channel>

Parameters:
<channel> OFF | CH1 | CH2 | CH2Is1 | | MULTi

Manual operation: See "Channel" on page 186
See "Channel" on page 195
See "Channel" on page 203
See "Channel" on page 217

OUTPut:IMPedance <impedance>

Parameters:
<impedance> R25 | R600

Manual operation: See "Impedance" on page 188

OUTPut:TYPE <type>

Parameters:
<type> BALanced | UNBalanced

Manual operation: See "Output Type " on page 187

SOURce:VOLTage:MAXimum <maximum>

Parameters:
<maximum> float

Manual operation: See "Max Voltage" on page 189

SOURce:VOLTage:RANGe <range>

Parameters:
<range> AUTO | FIXed

Manual operation: See "Volt Range" on page 188

7.3.2.3 Configuring the Digital Generator

- `OUTPut:AUDiobits` on page 662
- `OUTPut:CHANnel` on page 661
- `OUTPut:IMPedance` on page 661
- `OUTPut:IMPedance:UNBalanced?` on page 662
- `OUTPut:SAMPle:MODE` on page 662
- `OUTPut:SIGNal:BALanced:LEVel` on page 662
- `OUTPut:SIGNal:LEVel` on page 662

- SOURce:SYNC:INPut on page 662
- SOURce:SYNC:TERMination on page 663
- SOURce:SYNC:TO on page 663

OUTPut:AUDiobits <audiobits>

Parameters:
<audiobits> integer

Manual operation: See "Audio Bits " on page 199
See "Audio Bits " on page 206

OUTPut:IMPedance:UNBalanced?

Parameters:
<unbalanced> R600 | R25

Usage: Query only

Manual operation: See "Impedance" on page 188

OUTPut:SAMPle:MODE <mode>

Parameters:
<mode> F32 | F44 | F48 | F88 | F96 | F176 | F192 | VALue | F08 | F11 | F16 | F22 | AUTO

Manual operation: See "Sample Frequency" on page 198
See "Sample Freq" on page 204
See "Sample Freq" on page 218

OUTPut:SIGNal:BALanced:LEVel <level>

Parameters:
<level> float

Manual operation: See "Bal Ampl" on page 199

OUTPut:SIGNal:LEVel <level>

Parameters:
<level> float

Manual operation: See "Unbal Ampl" on page 199

SOURce:SYNC:INPut <input>

Parameters:
<input> BALanced | UNBalanced

Manual operation: See "Sync Input" on page 197

SOURce:SYNC:TERMination <termination>

Parameters:
<termination> R75 | RHIGH

Manual operation: See "Termination" on page 197

SOURce:SYNC:TO <to>

Parameters:
<to> INTClock | GCLock | EDARs | ECLK | EICLk | INTern | EXTMasterclock | EXTWordclock | HINTern | HAUXinput

Manual operation: See "Sync To" on page 196
See "Sync To" on page 203
See "Sync To" on page 217

7.3.2.4 Configuring the I2S-Generator

- `OUTPut:AUDiobits` on page 662
- `OUTPut:BCLK:FREQuency?` on page 663
- `OUTPut:CHANnel` on page 661
- `OUTPut:FBIT` on page 664
- `OUTPut:FORMat` on page 664
- `OUTPut:FSHape` on page 664
- `OUTPut:FSYNc:FREQuency?` on page 664
- `OUTPut:MCHannels<n2>` on page 664
- `OUTPut:MCLKratio` on page 665
- `OUTPut:POLarity` on page 665
- `OUTPut:SAMPle:FREQuency` on page 665
- `OUTPut:SAMPle:MODE` on page 662
- `OUTPut:WLENgth` on page 665
- `OUTPut:WOFFset` on page 665
- `SOURce:SYNC:TO` on page 663

OUTPut:BCLK:FREQuency?

Return values:
<argument> float

Usage: Query only

Manual operation: See "BClk Freq" on page 205

OUTPut:FBIT <fbit>

Parameters:
<fbit> MSB | LSB

Manual operation: See "First Bit" on page 206

OUTPut:FORMat <format>

Parameters:
<format> SI2S | USERdefined

Manual operation: See "Format" on page 206

OUTPut:FSHape <fshape>

Parameters:
<fshape> SQUpuls | BITPulse

Manual operation: See "Fsync Shape" on page 206

OUTPut:FSYNc:FREQuency?

Return values:
<argument> float

Usage: Query only

Manual operation: See "MClk Freq" on page 205

OUTPut:MCHannels<n2> <mchannels>

Suffix:
<n2> 1 to 10
<n2> = 1 to 8 when option R&S UPP-B4 is implemented and the I^2D generator is selected, or when the HDMI generator with audio format "PCM 8 Ch Layer 1" is selected.
<n2> = 3 to 10 when option R&S UPP-B8 is implemented and the analog or digital audio generator is selected.

Parameters:
<mchannels> ON | OFF

Manual operation: See "Gen Channels" on page 187
See "Gen Channels" on page 196
See "Gen Channels" on page 203
See "Gen Channels" on page 217
See "Meas Channels" on page 303

OUTPut:MCLKratio <mclkratio>

Parameters:
<mclkratio> M64 | M96 | M128 | M192 | M256 | M384 | M512

Manual operation: See "MClk Ratio" on page 205

OUTPut:POLarity <polarity>

Parameters:
<polarity> LFTLow | NEGative | LFTHigh | POSitive

Manual operation: See "Fsync Polarity" on page 207

OUTPut:SAMPle:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Sample Frequency" on page 198
See "Sample Freq" on page 204
See "Sample Freq Value" on page 218

OUTPut:WLENgth <wlength>

Parameters:
<wlength> W16 | W24 | W32

Manual operation: See "Word Length " on page 204

OUTPut:WOFFset <woffset>

Parameters:
<woffset> integer

Manual operation: See "Word Offset" on page 207

7.3.2.5 Configure HDMI Generator

- `OUTPut:CHANnel` on page 661
- `OUTPut:MCHannels<n2>` on page 664
- `OUTPut:SAMPle:FREQuency` on page 665
- `OUTPut:SAMPle:MODE` on page 662
- `SOURce:FREQuency:REFerence` on page 660
- `SOURce:VOLTage:REFerence` on page 660
- `SOURce:HDMI:AUDio:FORMat` on page 666
- `SOURce:HDMI:SARC` on page 666

- SOURce:HDMI:VIDeo:COLor:DEPTh on page 666
- SOURce:HDMI:VIDeo:CONTent on page 666
- SOURce:HDMI:VIDeo:FORMat? on page 666
- SOURce:HDMI:VIDeo:FREQuency on page 667
- SOURce:HDMI:VIDeo:RESolution on page 667
- SOURce:HDMI:VIDeo:SOURce on page 667
- SOURce:SYNC:TO on page 663

SOURce:HDMI:AUDio:FORMat <format>

Parameters:
<format> PCM2ch | PCM8ch | DBD | DBDP

Manual operation: See "Audio Format" on page 216

SOURce:HDMI:SARC <sarc>

Parameters:
<sarc> LOOPback | DAGen

Manual operation: See "Sink ARC" on page 198

SOURce:HDMI:VIDeo:COLor:DEPTh <depth>

Parameters:
<depth> D08 | D10 | D12

Manual operation: See "Color Depth" on page 215

SOURce:HDMI:VIDeo:CONTent <content>

Parameters:
<content> MONochrom | LIPSync | BERT | PATTern

Manual operation: See "Content" on page 214

SOURce:HDMI:VIDeo:FORMat? <format>

Parameters:
<format> string

Usage: Query only

Manual operation: See "Format No" on page 214

SOURce:HDMI:VIDeo:FREQuency <frequency>

Parameters:

<frequency> HZ23 | HZ24 | HZ25 | HZ29 | HZ30 | HZ50 | HZ59 | HZ60 | HZ100 | HZ119 | HZ120

Manual operation: See "Format Freq" on page 213

SOURce:HDMI:VIDeo:RESolution <resolution>

Parameters:

<resolution> P640x480_4x3 | P720x576_4x3 | P720x576_16x9 | I720x576_4x3 | I720x576_16x9 | P720x480_4x3 | P720x480_16x9 | I720x480_4x3 | I720x480_16x9 | P1280x720_16x9 | P1920x1080_16x9 | I1920x1080_16x9

Manual operation: See "Format Resol" on page 213

SOURce:HDMI:VIDeo:SOURce <source>

Parameters:

<source> INTern | AXINput

Manual operation: See "Source" on page 213

7.3.3 Generator Signals

The generator signals are defined in the `SOURce` subsystem. The type of generator signal is selected wirth command `SOURce:FUNCtion`.

- `SOURce:FUNCtion` on page 668

7.3.3.1 Sine

- `MMEMory:LOAD:OEQualize` on page 668
- `SOURce:FILTer` on page 740
- `SOURce:FREQuency<n2>` on page 668
- `SOURce:FUNCtion` on page 668
- `SOURce:SIGChange` on page 669
- `SOURce:SINusoid:DITHer` on page 669
- `SOURce:SINusoid:DITHer:STATe` on page 669
- `SOURce:VOLTage<n2>` on page 669
- `SOURce:VOLTage:EQUalize` on page 670
- `SOURce:VOLTage:OFFSet<n3>` on page 670
- `SOURce:VOLTage:OFFSet<n3>:STATe` on page 670

- SOURce:VOLTage:SELect on page 673

MMEMory:LOAD:OEQualize <oequalize>

Parameters:

<oequalize> string
filename

Manual operation: See "Equalizer / Equalizer Ch1" on page 227
See "Equalizer" on page 233
See "Equalizer" on page 238
See "Equalizer" on page 243
See "Equalizer" on page 258
See "Equal File" on page 265

SOURce:FREQuency<n2> <frequency>

Suffix:

<n2> 1...32 (Multisine) / 1 | 2 (Mod Dist)
The suffix selects the sine line for Multisine and Mod Dist generator signals.
For multisine, the suffix selects one of the sinewave 1 to 32.
For Mod Dist, suffix 1 or no suffix selects the upper frequency and suffix 2 the lower frequency.
For all other generator signals, the suffix is irrelevant and must be omitted.

Parameters:

<frequency> float

Manual operation: See "Frequency" on page 223
See "Frequency" on page 225
See "Freq Ch1" on page 226
See "Freq No i" on page 230
See "Frequency" on page 232
See "Upper Freq" on page 235
See "Lower Freq" on page 235
See "Upper Freq" on page 237
See "Frequency" on page 252
See "Frequency" on page 264

SOURce:FUNCtion <function>

Parameters:

<function> SINusoid | MULTisine | BURSt | | MDISt | DFD | RANDom | USER | ARBitrary | POLarity | STEReo | DC | PLAY | UNIVersal | LIPSync

SOURce:SIGChange <sigchange>

Parameters:
<sigchange> ON | OFF

Manual operation: See "Signal change at zero crossing" on page 223
See "Signal change at zero crossing" on page 226

SOURce:SINusoid:DITHer <dither>

Parameters:
<dither> float

Manual operation: See "Dither" on page 222
See "Dither" on page 224
See "Dither" on page 234
See "Dither" on page 237
See "Dither" on page 255

SOURce:SINusoid:DITHer:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Dither" on page 222
See "Dither" on page 224
See "Dither" on page 234
See "Dither" on page 237
See "Dither" on page 255

SOURce:VOLTage<n2> <voltage>

Suffix:
<n2> 1...32 (Multisine)
The suffix selects one of the sinewave 1 to 32 for Multisine generator signals.
For all other generator signals, the suffix is irrelevant and must be omitted.

Parameters:
<voltage> float

Manual operation: See "Voltage" on page 223
See "Volt Ch1" on page 226
See "Volt No i" on page 230
See "Voltage" on page 232
See "Volt Peak Ch1" on page 250
See "Total RMS" on page 252
See "Voltage" on page 264

SOURce:VOLTage:EQUalize <equalize>

Parameters:
<equalize> integer

Manual operation: See "Equalizer / Equalizer Ch1" on page 227
See "Equalizer" on page 233
See "Equalizer" on page 238
See "Equalizer" on page 243
See "Equalizer" on page 258
See "Equalizer" on page 265

SOURce:VOLTage:OFFSet<n3> <offset>

Parameters:
<offset> float

Manual operation: See "DC Offset" on page 224
See "Offset Ch1" on page 228
See "DC Offset" on page 231
See "DC Offset" on page 233
See "DC Offset" on page 236
See "DC Offset" on page 238
See "DC Offset" on page 243
See "DC Offset" on page 245
See "DC Offset" on page 252

SOURce:VOLTage:OFFSet<n3>:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "DC Offset" on page 224
See "DC Offset" on page 228
See "Offset Ch2" on page 228
See "DC Offset" on page 231
See "DC Offset" on page 233
See "DC Offset" on page 236
See "DC Offset" on page 238
See "DC Offset" on page 243
See "DC Offset" on page 245
See "DC Offset" on page 252

7.3.3.2 Stereo Sine

- `MMEMory:LOAD:STEReo<n3>:OEQualize` on page 671
- `MMEMory:LOAD:OEQualize` on page 668
- `SOURce:FILTer:CHANnels` on page 671
- `SOURce:FREQuency<n2>` on page 668

- SOURce:FREQuency:CH2Stereo on page 671
- SOURce:FREQuency:SELect on page 672
- SOURce:FUNCtion on page 668
- SOURce:PHASe<n2> on page 672
- SOURce:SIGChange on page 669
- SOURce:SINusoid:DITHer on page 669
- SOURce:SINusoid:DITHer:STATe on page 669
- SOURce:STEReo<n2>:FILTer on page 740
- SOURce:VOLTage<n2> on page 669
- SOURce:VOLTage:CH2Stereo on page 672
- SOURce:VOLTage:EQUalize on page 670
- SOURce:VOLTage:EQUalize:CHANnels on page 672
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:OFFSet:CHANnels on page 672
- SOURce:VOLTage:OFFSet<n3>:STATe on page 670
- SOURce:VOLTage:RATio on page 672
- SOURce:VOLTage:SELect on page 673
- SOURce:VOLTage:STEReo<n3>:EQUalize on page 673

MMEMory:LOAD:STEReo<n3>:OEQualize <oequalize>

Suffix:
<n3> 1 | 2
Stereo channel 1 or 2

Parameters:
<oequalize> string

Manual operation: See "Equalizer Ch2" on page 228

SOURce:FILTer:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "Filter" on page 227
See "Filter" on page 251

SOURce:FREQuency:CH2Stereo <ch2stereo>

Parameters:
<ch2stereo> float

Manual operation: See "Freq Ch2" on page 226

SOURce:FREQuency:SELect <select>

Parameters:
<select> FQPH | FQFQ

Manual operation: See "Freq Mode" on page 224

SOURce:PHASe<n2> <phase>

Suffix:
<n2> 1...32
The suffix selects one of the sinewave 1 to 32 for Multisine generator signal.
For all other generator signals, the suffix is irrelevant and must be omitted.

Parameters:
<phase> float

Manual operation: See "Phase Ch2/1" on page 226
See "Phase No i" on page 230

SOURce:VOLTage:CH2Stereo <ch2stereo>

Parameters:
<ch2stereo> float

Manual operation: See "Volt Ch2" on page 226
See "Volt Peak Ch2" on page 250

SOURce:VOLTage:EQUalize:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "Equalizer" on page 227

SOURce:VOLTage:OFFSet:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "DC Offset" on page 228

SOURce:VOLTage:RATio <ratio>

Parameters:
<ratio> float

Manual operation: See "Volt Ch2/1" on page 226
See "Volt LF:UF" on page 235
See "Volt Ch2/1" on page 250

SOURce:VOLTage:SELect <select>

Parameters:
<select> VLRT | VLVL

Manual operation: See "Volt Mode" on page 225
See "Volt Mode" on page 250

SOURce:VOLTage:STEReo<n3>:EQUalize <equalize>

Parameters:
<equalize> integer | ON | OFF

Manual operation: See "Equalizer Ch2" on page 228

7.3.3.3 Multisine

- `MMEMory:LOAD:OEQualize` on page 668
- `SOURce:FILTer` on page 740
- `SOURce:FREQuency<n2>` on page 668
- `SOURce:FUNCtion` on page 668
- `SOURce:FUNCtion:MODE` on page 673
- `SOURce:MULTisine:COUNt` on page 674
- `SOURce:PHASe<n2>` on page 672
- `SOURce:RANDom:SPACing:FREQuency` on page 674
- `SOURce:RANDom:SPACing:MODE` on page 674
- `SOURce:VOLTage<n2>` on page 669
- `SOURce:VOLTage:CRESTfactor:MODE` on page 674
- `SOURce:VOLTage:EQUalize` on page 670
- `SOURce:VOLTage:OFFSet<n3>` on page 670
- `SOURce:VOLTage:OFFSet<n3>:STATe` on page 670
- `SOURce:VOLTage:RMS` on page 674
- `SOURce:VOLTage:TOTal` on page 674
- `SOURce:VOLTage:TOTal:GAIN` on page 675

SOURce:FUNCtion:MODE <mode>

Parameters:
<mode> EQUalvoltage | DEFinedvoltage | IEC268 | IEC118

Manual operation: See "Voltage Mode" on page 229
See "Mode" on page 236

SOURce:MULTisine:COUNt <count>

Parameters:
<count> integer

Manual operation: See "No of Sine" on page 230

SOURce:RANDom:SPACing:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Spacing" on page 229
See "Spacing" on page 241

SOURce:RANDom:SPACing:MODE <mode>

Parameters:
<mode> ATRack | USERdefined

Manual operation: See "Spacing" on page 229
See "Spacing" on page 241

SOURce:VOLTage:CRESTfactor:MODE <mode>

Parameters:
<mode> MINimized | DPHase

Manual operation: See "Crest Factor" on page 229

SOURce:VOLTage:RMS <rms>

Parameters:
<rms> float

Manual operation: See "Total RMS" on page 231
See "Volt RMS" on page 243
See "Volt RMS" on page 245

SOURce:VOLTage:TOTal <total>

Parameters:
<total> float

Manual operation: See "Total Peak" on page 230
See "Total Voltage" on page 235
See "Total Voltage" on page 238
See "Volt Peak" on page 242
See "Volt Peak" on page 245
See "Total Peak" on page 252
See "Voltage" on page 253

SOURce:VOLTage:TOTal:GAIN <gain>

Parameters:
<gain> float

Manual operation: See "Total Gain" on page 230

7.3.3.4 Sine Burst

- `MMEMory:LOAD:OEQualize` on page 668
- `SOURce:FILTer` on page 740
- `SOURce:FREQuency<n2>` on page 668
- `SOURce:FUNCtion` on page 668
- `SOURce:ONTime` on page 675
- `SOURce:ONTime:DELay` on page 675
- `SOURce:VOLTage<n2>` on page 669
- `SOURce:VOLTage:EQUalize` on page 670
- `SOURce:VOLTage:OFFSet<n3>` on page 670
- `SOURce:VOLTage:OFFSet<n3>:STATe` on page 670

SOURce:ONTime <ontime>

Parameters:
<ontime> float

Manual operation: See "On Time" on page 232
See "On Time" on page 264

SOURce:ONTime:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Burst on Delay" on page 233

7.3.3.5 Mod Dist

- `SOURce:FILTer` on page 740

- SOURce:FREQuency<n2> on page 668
- SOURce:FUNCtion on page 668
- SOURce:SINusoid:DITHer on page 669
- SOURce:SINusoid:DITHer:STATe on page 669
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:OFFSet<n3>:STATe on page 670
- SOURce:VOLTage:RATio on page 672
- SOURce:VOLTage:TOTal on page 674

7.3.3.6 DFD

- MMEMory:LOAD:OEQualize on page 668
- SOURce:FILTer on page 740
- SOURce:FREQuency<n2> on page 668
- SOURce:FREQuency:DIFFerence on page 676
- SOURce:FREQuency:MEAN on page 676
- SOURce:FUNCtion on page 668
- SOURce:FUNCtion:MODE on page 673
- SOURce:SINusoid:DITHer on page 669
- SOURce:SINusoid:DITHer:STATe on page 669
- SOURce:VOLTage:EQUalize on page 670
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:TOTal on page 674

SOURce:FREQuency:DIFFerence <difference>

Parameters:
<difference> float

Manual operation: See "Diff Freq" on page 238

SOURce:FREQuency:MEAN <mean>

Parameters:
<mean> float

Manual operation: See "Mean Freq" on page 237
See "Mean Freq" on page 242

7.3.3.7 Random

- MMEMory:LOAD:ARBitrary on page 678
- MMEMory:LOAD:OEQualize on page 668

- SOURce:FILTer on page 740
- SOURce:FREQuency:MEAN on page 676
- SOURce:FUNCtion on page 668
- SOURce:RANDom:FREQuency:LOWer on page 677
- SOURce:RANDom:FREQuency:UPPer on page 677
- SOURce:RANDom:SHAPe on page 677
- SOURce:RANDom:SPACing:FREQuency on page 674
- SOURce:RANDom:SPACing:MODE on page 674
- SOURce:VOLTage:EQUalize on page 670
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:OFFSet<n3>:STATe on page 670
- SOURce:VOLTage:RMS on page 674
- SOURce:VOLTage:TOTal on page 674

SOURce:RANDom:FREQuency:LOWer <lower>

Parameters:
<lower> float

Manual operation: See "Lower Freq" on page 242

SOURce:RANDom:FREQuency:UPPer <upper>

Parameters:
<upper> float

Manual operation: See "Upper Freq" on page 242

SOURce:RANDom:SHAPe <shape>

Parameters:
<shape> FILE | WHITe | PINK | TOCTave

Manual operation: See "Shape" on page 239

7.3.3.8 Arbitrary

- MMEMory:LOAD:ARBitrary on page 678
- SOURce:FILTer on page 740
- SOURce:FUNCtion on page 668
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:OFFSet<n3>:STATe on page 670
- SOURce:VOLTage:RMS on page 674

- SOURce:VOLTage:TOTal on page 674

MMEMory:LOAD:ARBitrary <arbitrary>

Parameters:
<arbitrary> string

Manual operation: See "File" on page 244
See "File" on page 246

7.3.3.9 Play

Playing waveforms requires option R&S UPP-B6.

- MMEMory:LOAD:ARBitrary on page 678
- SOURce:FILTer on page 740
- SOURce:FILTer:CHANnels on page 671
- SOURce:FUNCtion on page 668
- SOURce:PLAY:CHANnel on page 678
- SOURce:PLAY:MODE on page 678
- SOURce:PLAY:MUTing on page 678
- SOURce:PLAY:RESTart on page 679
- SOURce:PLAY:SCALepktofs on page 679
- SOURce:PLAY:TIME on page 679
- SOURce:VOLTage:OFFSet<n3> on page 670
- SOURce:VOLTage:OFFSet<n3>:STATe on page 670
- SOURce:VOLTage:TOTal on page 674

SOURce:PLAY:CHANnel <channel>

Parameters:
<channel> MLEFt | MRIGht | STEReo

Manual operation: See "Channel" on page 247

SOURce:PLAY:MODE <mode>

Parameters:
<mode> TOCont | TOSingle | TICont | TISingle

Manual operation: See "Play Mode" on page 249

SOURce:PLAY:MUTing <muting>

Parameters:
<muting> OFF | AFTermeas

Manual operation: See "Muting" on page 241
See "Muting" on page 248

SOURce:PLAY:RESTart <state>

Parameters:
<state> OFF | AUTO | ONCE

Manual operation: See "Restart" on page 248
See "Restart" on page 257

SOURce:PLAY:SCALepktofs <scalepktofs>

Parameters:
<scalepktofs> ON | OFF

Manual operation: See "Scale Pk to FS" on page 247

SOURce:PLAY:TIME <time>

Parameters:
<time> float

Manual operation: See "Time" on page 249

7.3.3.10 Polarity

- SOURce:FREQuency<n2> on page 668
- SOURce:FUNCtion on page 668
- SOURce:VOLTage<n2> on page 669
- SOURce:VOLTage:TOTal on page 674

7.3.3.11 DC (Direct Current Voltage)

- SOURce:FUNCtion on page 668
- SOURce:VOLTage:TOTal on page 674

7.3.3.12 Universal

- MMEMory:LOAD:OEQualize on page 668
- MMEMory:LOAD:MCHannel<n3>:SINE:ARBitrary on page 680
- MMEMory:LOAD:MCHannel<n3>:SINE:EQUalize on page 681
- SOURce:ACHSine:FREQuency on page 681
- SOURce:ACHSine:STATe on page 681
- SOURce:ACHSine:VOLTage on page 681

- SOURce:ARBitrary:MODE on page 681
- SOURce:ARBitrary:RELoad on page 682
- SOURce:ARBitrary:TIME on page 682
- SOURce:FREQuency<n2> on page 668
- SOURce:FUNCtion on page 668
- SOURce:LIPSync:PATTern:AUDioactive:COLor:STRing on page 682
- SOURce:LIPSync:PATTern:MUTE:COLor:STRing on page 682
- SOURce:MCHannel<n2>:ACHSine:STATe on page 682
- SOURce:MCHannel<n2>:FILTer on page 740
- SOURce:MCHannel<n2>:GAIN on page 682
- SOURce:MCHannel<n2>:LIMittofs on page 683
- SOURce:MCHannel<n2>:SINE:ARBitrary:DELay on page 683
- SOURce:MCHannel<n2>:SINE:ARBitrary:STATe on page 683
- SOURce:MCHannel<n2>:SINE:ARBitrary:VOLTage on page 683
- SOURce:MCHannel<n2>:SINE:EQUalize:STATe on page 683
- SOURce:MCHannel<n2>:SINE:FREQuency on page 683
- SOURce:MCHannel<n2>:SINE:OFFSet:STATe on page 683
- SOURce:MCHannel<n2>:SINE:OFFSet:VOLTage on page 684
- SOURce:MCHannel<n2>:SINE:PHASe on page 684
- SOURce:MCHannel<n2>:SINE:STATe on page 684
- SOURce:MCHannel<n2>:SINE:VOLTage on page 684
- SOURce:MCHannel<n2>:TOTal:GAIN on page 684
- SOURce:PLAY:RESTart on page 679
- SOURce:ONTime on page 675
- SOURce:SCHSettings:CHANnel on page 684
- SOURce:SCHSettings:TTOChannels on page 684
- SOURce:SINusoid:DITHer on page 669
- SOURce:SINusoid:DITHer:STATe on page 669
- SOURce:VOLTage<n2> on page 669
- SOURce:VOLTage:EQUalize on page 670

MMEMory:LOAD:MCHannel<n3>:SINE:ARBitrary <arbitrary>

Suffix:

<n3> 1 to 10
<n3> = 1 to 8 either when option R&S UPP-B4 is implemented and the I^2D generator is selected, or when the HDMI generator with audio format "PCM 8 Ch Layer 1" is selected.
<n3> = 3 to 10 when option R&S UPP-B8 is implemented and theanalog or digital audio generator is selected.

Parameters:
<arbitrary> <file name>

Manual operation: See "Arbitrary" on page 261

MMEMory:LOAD:MCHannel<n3>:SINE:EQUalize <equalize>

Suffix:
<n3> 1...10
<n3> = 1 bis 8, wenn die Option R&S UPP-B4 eingebaut ist und das Generatorinstrumente I^2S eingestellt ist oder wenn das Generatorinstrument HDMI in Verbindung mit Audio Format = PCM 8 Ch Layer 1 eingestellt ist.
<n3> = 3 bis 10, wenn die Option R&S UPP-B8 eingebaut ist und das Generatorinstrument Analog oder Digital Audio eingestellt ist.

Parameters:
<equalize> <file name>

Manual operation: See "Equalizer" on page 260

SOURce:ACHSine:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Frequency" on page 258

SOURce:ACHSine:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "All Chan Sine" on page 256

SOURce:ACHSine:VOLTage <voltage>

Parameters:
<voltage> float

Manual operation: See "Voltage" on page 258

SOURce:ARBitrary:MODE <mode>

Parameters:
<mode> TOCont | TIMManual

Manual operation: See "Arbitrary Mode" on page 256

SOURce:ARBitrary:RELoad <state>

Parameters:
<state> ONCE | EXEC

Manual operation: See "Reload" on page 261

SOURce:ARBitrary:TIME <time>

Parameters:
<time> float

Manual operation: See "Time" on page 261

SOURce:LIPSync:PATTern:AUDioactive:COLor:STRing <string>

Parameters:
<string> string

SOURce:LIPSync:PATTern:MUTE:COLor:STRing <string>

Parameters:
<string> string

SOURce:MCHannel<n2>:ACHSine:STATe <state>

Suffix:
<n2> 1 to 10
Note: The following description of the suffix is valid for all `SOURce:MCHannel:...` commands.
<n2> = 1 to 8 when option UPP-B4 is implemented and the I^2D generator is selected, or when the HDMI generator with audio format "PCM 8 Ch Layer 1" is selected.
<n2> = 3 to 10 when option UPP-B8 is implemented and the analog or digital audio generator is selected.

Parameters:
<state> integer
ON | OFF

Manual operation: See "All Chan Sine" on page 262
See "Gain" on page 262

SOURce:MCHannel<n2>:GAIN <gain>

Parameters:
<gain> float

Manual operation: See "All Chan Sine" on page 262
See "Gain" on page 262

SOURce:MCHannel<n2>:LIMittofs <limittofs>

Parameters:
<limittofs> ON | OFF

Manual operation: See "Limit to Max" on page 262

SOURce:MCHannel<n2>:SINE:ARBitrary:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Delay" on page 261

SOURce:MCHannel<n2>:SINE:ARBitrary:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Arbitrary" on page 261

SOURce:MCHannel<n2>:SINE:ARBitrary:VOLTage <voltage>

Parameters:
<voltage> float

Manual operation: See "Arbitrary" on page 261

SOURce:MCHannel<n2>:SINE:EQUalize:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Equalizer" on page 260

SOURce:MCHannel<n2>:SINE:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Frequency" on page 260

SOURce:MCHannel<n2>:SINE:OFFSet:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "DC Offset" on page 260

SOURce:MCHannel<n2>:SINE:OFFSet:VOLTage <voltage>

Parameters:
<voltage> float

Manual operation: See "DC Offset" on page 260

SOURce:MCHannel<n2>:SINE:PHASe <phase>

Parameters:
<phase> float

Manual operation: See "Phase" on page 260

SOURce:MCHannel<n2>:SINE:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Sine" on page 259

SOURce:MCHannel<n2>:SINE:VOLTage <voltage>

Parameters:
<voltage> float

Manual operation: See "Voltage" on page 260

SOURce:MCHannel<n2>:TOTal:GAIN <gain>

Parameters:
<gain> float

Manual operation: See "Total Gain" on page 263

SOURce:SCHSettings:CHANnel <channel>

Parameters:
<channel> integer

Manual operation: See "Channel" on page 259

SOURce:SCHSettings:TTOChannels <ttochannels>

Parameters:
<ttochannels> ON | OFF

Manual operation: See "Track to other channels" on page 258

7.3.4 Digital Audio Protocol Generator

The Digital Audio Protocol Generator requires option R&S UPP-K21.

The Digital Audio Protocol Generator requires one of the options R&S UPP-B2 (Digital audio interfaces) or R&S UPP-B4 (HDMI and digital audio interfaces) and in any case oOption R&S UPP-K21 (Digital audio protocol) (see chapter 5.8, "Protocol Generator", on page 266) .

- SOURce:PROTocol:AZERo on page 685
- SOURce:PROTocol:CH<n3>:BYTE<n4> on page 685
- SOURce:PROTocol:CRC on page 686
- SOURce:PROTocol:FILE on page 686
- SOURce:PROTocol:MODE on page 686
- SOURce:PROTocol:NUMerical:BYTE on page 686
- SOURce:PROTocol:NUMerical:CH on page 686
- SOURce:PROTocol:NUMerical:VALue on page 686
- SOURce:PROTocol:VALidity on page 686

SOURce:PROTocol:AZERo <state>

Parameters:

<state> ONCE | EXEC

Manual operation: See "All Bits = Zero" on page 268

SOURce:PROTocol:CH<n3>:BYTE<n4> <byte>

This command combines the following two commands in one :

- SOURce:PROTocol:NUMerical:BYTE on page 686
- SOURce:PROTocol:NUMerical:VALue on page 686

Suffix:

<n3> channel 1 or 2

<n4> byte 0 to 4

Parameters:

<byte> 0 to 255

decimal bit equivalent

Example: `SOUR:PROT:CH:BYTE2 31`

Sets the protocol data of byte 2 (the third byte) to 31 = 1Fh = 00011111b .

Manual operation: See "Byte Number" on page 269

See "Value " on page 269

SOURce:PROTocol:CRC <crc>

Parameters:
<crc> ON | OFF

Manual operation: See "CRC" on page 268

SOURce:PROTocol:FILE <file>

Parameters:
<file> <file name>

Manual operation: See "Channel Status File" on page 268

SOURce:PROTocol:MODE <mode>

Parameters:
<mode> AUTomatic | AUTOmatic | CONSumer | PROFessional | FILE

Manual operation: See "Coding Mode" on page 267

SOURce:PROTocol:NUMerical:BYTE <byte>

Parameters:
<byte> integer

Manual operation: See "Byte Number" on page 269

SOURce:PROTocol:NUMerical:CH <ch>

Parameters:
<ch> integer

SOURce:PROTocol:NUMerical:VALue <value>

Parameters:
<value> integer

Manual operation: See "Value " on page 269

SOURce:PROTocol:VALidity <validity>

Parameters:
<validity> NONE | CH1And2

Manual operation: See "Validity" on page 268

7.3.5 Sweeps

The SOURce:SWEeps:... commands set the sweeps. List sweeps are loaded with commands of the MMEMory-Subsystem.

- MMEMory:LOAD:DWELl on page 687
- MMEMory:LOAD:FREQuency on page 688
- MMEMory:LOAD:PHASe on page 688
- MMEMory:LOAD:VOLTage on page 688
- SOURce:SWEep:CONTrol on page 688
- SOURce:SWEep:DWELl on page 688
- SOURce:SWEep:FREQuency:HALT on page 688
- SOURce:SWEep:FREQuency:HALT:VALue on page 688
- SOURce:SWEep:FREQuency:POINts on page 689
- SOURce:SWEep:FREQuency:SPACing on page 689
- SOURce:SWEep:FREQuency:STARt on page 689
- SOURce:SWEep:FREQuency:STEP on page 689
- SOURce:SWEep:FREQuency:STOP on page 689
- SOURce:SWEep:NEXTstep on page 688
- SOURce:SWEep:PHASe:HALT on page 688
- SOURce:SWEep:PHASe:HALT:VALue on page 688
- SOURce:SWEep:PHASe:POINts on page 689
- SOURce:SWEep:PHASe:SPACing on page 689
- SOURce:SWEep:PHASe:STARt on page 689
- SOURce:SWEep:PHASe:STEP on page 689
- SOURce:SWEep:PHASe:STOP on page 689
- SOURce:SWEep:VOLTage:HALT on page 688
- SOURce:SWEep:VOLTage:HALT:VALue on page 688
- SOURce:SWEep:VOLTage:POINts on page 689
- SOURce:SWEep:VOLTage:SPACing on page 689
- SOURce:SWEep:VOLTage:STARt on page 689
- SOURce:SWEep:VOLTage:STEP on page 689
- SOURce:SWEep:VOLTage:STOP on page 689
- SOURce:SWEep:XAXis on page 689
- SOURce:SWEep:ZAXis on page 690

MMEMory:LOAD:DWELl <dwell>

Parameters:
<dwell> string

Manual operation: See "Next Step " on page 277

MMEMory:LOAD:FREQuency <frequency>
MMEMory:LOAD:PHASe <phase>
MMEMory:LOAD:VOLTage <voltage>
Parameters:
<voltage> string

Manual operation: See "Tot Volt File, Volt File" on page 282

SOURce:SWEep:CONTrol <control>

Parameters:
<control> OFF | ASWeep | ALISt

Manual operation: See "Sweep Ctrl" on page 235
See "Sweep Ctrl" on page 237
See "Sweep Ctrl" on page 253
See "Sweep Ctrl" on page 257
See "Sweep Ctrl" on page 273

SOURce:SWEep:DWELl <dwell>

Parameters:
<dwell> float

Manual operation: See "Next Step " on page 277

SOURce:SWEep:NEXTstep <nextstep>

Parameters:
<nextstep> DWELl | ASYNc | LIST

Manual operation: See "Next Step " on page 277

SOURce:SWEep:FREQuency:HALT <halt>
SOURce:SWEep:PHASe:HALT <halt>
SOURce:SWEep:VOLTage:HALT <halt>
Parameters:
<halt> VALue | MUTE

Manual operation: See "Halt" on page 283

SOURce:SWEep:FREQuency:HALT:VALue <value>
SOURce:SWEep:PHASe:HALT:VALue <value>
SOURce:SWEep:VOLTage:HALT:VALue <value>
Parameters:
<value> float

Manual operation: See "Halt value" on page 283

SOURce:SWEep:FREQuency:POINts <points>
SOURce:SWEep:PHASe:POINts <points>
SOURce:SWEep:VOLTage:POINts <points>
Parameters:
<points> integer

Manual operation: See "Points" on page 280

SOURce:SWEep:FREQuency:SPACing <spacing>
SOURce:SWEep:PHASe:SPACing <spacing>
SOURce:SWEep:VOLTage:SPACing <spacing>
Parameters:
<spacing> LINSteps | LOGSteps | LINPoints | LOGPoints

Manual operation: See "Spacing" on page 279

SOURce:SWEep:FREQuency:STARt <start>
SOURce:SWEep:PHASe:STARt <start>
SOURce:SWEep:VOLTage:STARt <start>
Parameters:
<start> float

Manual operation: See "Start" on page 279

SOURce:SWEep:FREQuency:STEP <step>
SOURce:SWEep:PHASe:STEP <step>
SOURce:SWEep:VOLTage:STEP <step>
Parameters:
<step> float

Manual operation: See "Step" on page 281

SOURce:SWEep:FREQuency:STOP <stop>
SOURce:SWEep:PHASe:STOP <stop>
SOURce:SWEep:VOLTage:STOP <stop>
Parameters:
<stop> float

Manual operation: See "Stop" on page 280

SOURce:SWEep:XAXis <state>

Parameters:
<state> FREQuency | VOLTage | PHASe

Manual operation: See "X-axis " on page 274

SOURce:SWEep:ZAXis <state>

Parameters:
<state> OFF | FREQuency | VOLTage | PHASe

Manual operation: See "Z-axis" on page 275

7.3.6 Rapid Deactivation of Outputs

The outputs of the Audio Analyzer can be switched off in case of malfunction.

OUTPut <output>

Parameters:
<output> ON | OFF

7.4 Analyzer Settings

The commands for selecting and setting the analyzer are described in the following sequence:

1. Selection of Analyzer
2. Setting the various analyzer types

How to start and configure are measurement is described in the following chapters.

For rapid deactivation of outputs see chapter 7.3.6, "Rapid Deactivation of Outputs", on page 690

7.4.1 Selecting the Analyzer

The analyzer is selected with the `INSTrument` command.

INSTrument<n1> <analyzer_type>

This command selects the generator or analyzer. The active selection is determined by suffx <n1> at `INSTrument`.

Suffix:
<n1> 1 | 2
Suffix 1 (or no suffix) at `INSTrument` defines that selection of the generator is active, see chapter 7.3.1, "Selecting the Generator", on page 659.
Suffix 2 at `INSTrument` defines that selection of the analyzer is active,

Parameters:
<analyzer_type> A8CHannel | ANLG | DIG | I2SBoard | | HDMI

Manual operation: See "Instrument" on page 287

7.4.2 Configuring the Analog Analyzer

The settings for the analog Analyzer are performed in the `INPut`, `SENSe` and `TRIGger` subsystems.

- `INPut<n1>:BANDwidth:MODE` on page 691
- `INPut<n1>:COUPling` on page 691
- `INPut<n1>:COUPling:CHANnels` on page 691
- `INPut<n1>:FILTer` on page 737
- `INPut<n1>:MCHannels<n2>` on page 692
- `INPut:MIMPedance<n2>` on page 692
- `INPut:MIMPedance:CHANnels` on page 692
- `INPut<n1>:RANGe:CHANnels` on page 692
- `SENSe<n1>:MAX:FFT:SIZE` on page 692
- `SENSe<n1>:POWer:REFerence:RESistance` on page 693
- `SENSe<n1>:REFerence<n2>:CHANnel` on page 703
- `SENSe<n1>:VOLTage:RANGe<n3>:MODE` on page 693
- `SENSe:VOLTage:RANGe<n3>:VALue` on page 693
- `TRIGger:CHANnel` on page 703
- `TRIGger:SOURce` on page 704
- `TRIGger:DELay` on page 703

INPut<n1>:BANDwidth:MODE <mode>

Parameters:
<mode> B22 | B40 | B80

Manual operation: See "Bandwidth" on page 292

INPut<n1>:COUPling <coupling>

Suffix:
<n1> 1 ... 8 : Kanal 1 bis 8

Parameters:
<coupling> AC | DC

Manual operation: See "Chx Coupling" on page 292

INPut<n1>:COUPling:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "AC/DC Coupling" on page 291

INPut<n1>:MCHannels<n2> <mchannels>

Parameters:
<mchannels> ON | OFF

Manual operation: See "Meas Channels" on page 291
See "Meas Channel" on page 316

INPut:MIMPedance<n2> <mimpedance>

Suffix:
<n2> 1 to 8
<n2> = 1 for setting `INPut:MIMPedance:CHANnels TRACk`.
<n2> = 1 to 8 for setting `INPut:MIMPedance:CHANnels SPLit`. It denotes channel 1 to 8.

Parameters:
<mimpedance> R600 | R200K

Manual operation: See "Chx Imped" on page 293

INPut:MIMPedance:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "Impedance" on page 293

INPut<n1>:RANGe:CHANnels <channels>

Parameters:
<channels> TRACk | SPLit

Manual operation: See "Range" on page 293

SENSe<n1>:MAX:FFT:SIZE <size>

Parameters:
<size> S512 | S1K | S2K | S4K | S8K | S16K | S32K | S64K | S128K | S256K

Manual operation: See "Max FFT Size" on page 297
See "Max FFT Size" on page 300
See "Max FFT Size" on page 307
See "Max FFT Size" on page 319

SENSe<n1>:POWer:REFerence:RESistance <resistance>

Parameters:
<resistance> float

Manual operation: See "Ref Imped" on page 295

SENSe<n1>:VOLTage:RANGe<n3>:MODE <mode>

Suffix:
<n3> 1 to 8
<n3> = 1 for setting `INPut:MIMPedance:CHANnels TRACk`.
<n3> = 1 to 8 for setting `INPut:MIMPedance:CHANnels SPLit`. It denotes channel 1 to 8.

Parameters:
<mode> AUTO | FIXed | LOWer

Manual operation: See "Chx Range" on page 294

SENSe:VOLTage:RANGe<n3>:VALue <value>

Suffix:
<n3> 1 to 8
<n3> = 1 for setting `INPut:MIMPedance:CHANnels TRACk`.
<n3> = 1 to 8 for setting `INPut:MIMPedance:CHANnels SPLit`. It denotes channel 1 to 8.

Parameters:
<value> float

Manual operation: See "Chx Range" on page 294

7.4.3 Configuring the Digital Analyzer

The settings for the digital analyzer are performed in the `INPut` and `SENSe` subsystems.

- `INPut<n1>:AUDiobits` on page 694
- `INPut<n1>:CHANnel` on page 694
- `INPut<n1>:FILTer` on page 737
- `INPut<n1>:SAMPle:FREQuency` on page 694
- `INPut<n1>:SAMPle:FREQuency:MODE` on page 694
- `INPut<n1>:TYPE` on page 694
- `SENSe<n1>:MAX:FFT:SIZE` on page 692

INPut<n1>:AUDiobits <audiobits>

Parameters:
<audiobits> integer

Manual operation: See "Audio Bits" on page 299
See "Audio Bits " on page 303
See "Audio Bits" on page 316

INPut<n1>:CHANnel <channel>

Parameters:
<channel> CH1 | CH2 | CH2Is1 | BOTH | MULTi

Manual operation: See "Channel" on page 298
See "Channel" on page 302
See "Channel" on page 315

INPut<n1>:SAMPle:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Sample Freq" on page 299
See "Sample Freq" on page 304
See "Sample Freq" on page 317

INPut<n1>:SAMPle:FREQuency:MODE <mode>

Parameters:
<mode> F32 | F44 | F48 | F88 | F96 | F176 | F192 | VALue | F08 | F11 | F16 | F22 | AUTO

Manual operation: See "Sample Freq" on page 299
See "Sample Freq" on page 304
See "Sample Freq" on page 317

INPut<n1>:TYPE <type>

Suffix:
<n1> only suffix 1 or no suffix are allowed.

Parameters:
<type> BALanced | UNBalanced | DUNBalanced | SPDif | OPTical | INTern

Manual operation: See "Input" on page 300

7.4.4 Configuring the I²S Analyzer

The settings for the I²S analyzer are performed in the INPut and SENSe subsystems.

- INPut<n1>:AUDiobits on page 694
- INPut<n1>:BCLK:FREQuency? on page 695
- INPut<n1>:CHANnel on page 694
- INPut<n1>:FBIT on page 695
- INPut<n1>:FORMat on page 695
- INPut<n1>:FSLope on page 695
- INPut<n1>:INPut on page 696
- INPut<n1>:SAMPle:FREQuency on page 694
- INPut<n1>:SAMPle:FREQuency:MODE on page 694
- INPut<n1>:WLENgth on page 696
- INPut<n1>:WOFFset on page 696
- SENSe<n1>:MAX:FFT:SIZE on page 692

INPut<n1>:BCLK:FREQuency?

Return values:
<argument> integer

Usage: Query only

Manual operation: See "BClk Freq" on page 305

INPut<n1>:FBIT <fbit>

Parameters:
<fbit> MSB | LSB

Manual operation: See "First Bit" on page 305

INPut<n1>:FORMat <format>

Parameters:
<format> SI2S | USERdefined

Manual operation: See "Format" on page 305

INPut<n1>:FSLope <fslope>

Parameters:
<fslope> LFTFalling | LFTRising

Manual operation: See "Fsync Slope" on page 306

INPut<n1>:INPut <input>

Parameters:
<input> INTern | DSUB

Manual operation: See "Input" on page 305

INPut<n1>:WLENgth <wlength>

Parameters:
<wlength> W16 | W24 | W32

Manual operation: See "Word Length " on page 303

INPut<n1>:WOFFset <woffset>

Parameters:
<woffset> integer

Manual operation: See "Word Offset" on page 306

7.4.5 Configure HDMI Analyzer

.The settings for the HDMI Analyzer are performed in the `INPut`, `SENSe` and `TRIGger` subsystems.

- `INPut<n1>:CHANnel` on page 694
- `INPut<n1>:MCHannels<n2>` on page 692
- `INPut<n1>:AUDiobits` on page 694
- `INPut<n1>:SAMPle:FREQuency` on page 694
- `INPut<n1>:SAMPle:FREQuency:MODE` on page 694
- `INPut<n1>:FILTer` on page 737
- `INPut<n1>:RESYnc` on page 697
- `SENSe<n1>:FUNCtion` on page 719
- `SENSe<n1>:HDMI:AUDio:CODing` on page 697
- `SENSe<n1>:HDMI:AUDio:CTS` on page 697
- `SENSe<n1>:HDMI:AUDio:FORMat` on page 697
- `SENSe<n1>:HDMI:AUDio:INPut` on page 697
- `SENSe<n1>:HDMI:AUDio:N` on page 697
- `SENSe<n1>:HDMI:HDCP` on page 697
- `SENSe<n1>:HDMI:VIDeo:COLor:DEPTh` on page 698
- `SENSe<n1>:HDMI:VIDeo:FORMat` on page 698
- `SENSe<n1>:HDMI:VIDeo:TIMing` on page 698
- `SENSe<n1>:MAX:FFT:SIZE` on page 692

- SENSe<n1>:REFerence<n2>:CHANnel on page 703
- TRIGger:CHANnel on page 703

INPut<n1>:RESYnc <state>

Parameters:
<state> ONCE | EXEC

Manual operation: See "Hotplug detect" on page 319

SENSe<n1>:HDMI:AUDio:CODing <coding>

Parameters:
<coding> PCM | AUTodetect

Manual operation: See "Coding" on page 314

SENSe<n1>:HDMI:AUDio:CTS <cts>

Parameters:
<cts> integer

Manual operation: See "CTS" on page 315

SENSe<n1>:HDMI:AUDio:FORMat <format>

Parameters:
<format> PCM2ch | PCM8ch

Manual operation: See "Audio Format" on page 314

SENSe<n1>:HDMI:AUDio:INPut <input>

Parameters:
<input> SINK | SARC | DIUnbal | DIOptical

Manual operation: See "Input" on page 313

SENSe<n1>:HDMI:AUDio:N <n>

Parameters:
<n> integer

Manual operation: See "N" on page 315

SENSe<n1>:HDMI:HDCP <hdcp>

Parameters:
<hdcp> ON | OFF

Manual operation: See "HDCP" on page 312

SENSe<n1>:HDMI:VIDeo:COLor:DEPTh <depth>

Parameters:
<depth> D08 | D10 | D12

Manual operation: See "Color Depth" on page 312

SENSe<n1>:HDMI:VIDeo:FORMat <format>

Parameters:
<format> string

Manual operation: See "Format No" on page 311

SENSe<n1>:HDMI:VIDeo:TIMing <timing>

Parameters:
<timing> ON | OFF

Manual operation: See "Timings" on page 312

7.5 Triggering Measurements and Reading Results

This chapter describes how to start single measurements or continuous measurements and how to read results from the instrument by means of remote control commands.

These commands cannot be logged by means of the SCPI recording function.

7.5.1 Starting Measurements

See also chapter 5.15, "Starting Measurements", on page 322

Continuous measurement

This is the standard operating mode of the measurement system to which the Audio Analyzer is set on switch-on. All types of measurements that are activated are performed continuously. You can start a continuous measurement by pressing START. The START LED is on to indicate that the continuous measurement mode is active.

In this operation mode, every change in the generator, analyzer or filter bank triggers a restart of the continuous measurement in progress. This also applies to the `*RST` command and the loading of setups.

This ensures that the displayed measurement data is not corrupted by internal switching operations of the analyzer or by a change of the generator signal. The execution time of the setting commands in question takes a bit longer in comparison to a stopped measurement. To keep setting times as short as possible, you should execute longer command sequences in the "term"inated or "stop" state, i.e. during stopped measurements.

Single measurement

The Audio Analyzer carries out a single measurement for all measurement types activated; then the measurement system goes to the "Term"inated state. It is not mandatory that valid results be produced by the measurements: if an error occurs during a measurement, the result is indicated as being invalid. In such case, "----" rather than the measured value will be displayed in the associated result window. With remote control, a NAN ("not a number", >1.0e37) value will be returned. You can start a single measurement by pressing SINGLE. The START LED and the SINGLE LED are on to indicate that the single measurement mode is active. In this operation mode, all setting commands that occur after the measurement timing are executed without restart and therefore require less time than during a continuous measurement. This also applies to the `*RST` command and the loading of setups.

- `INITiate:CONTinuous` on page 700
- `INITiate:CONTinuous:TIMeout` on page 701
- `INITiate:FORCe` on page 702
- `INITiate` on page 702
- `ABORt` on page 703
- `SENSe<n1>:REFerence<n2>:CHANnel` on page 703
- `TRIGger:CHANnel` on page 703
- `TRIGger:COUNt` on page 703
- `TRIGger:DELay` on page 703
- `TRIGger:FREQuency:VARiation` on page 703
- `TRIGger:SOURce` on page 704
- `TRIGger:TIMer` on page 704
- `TRIGger:VOLTage:VARiation` on page 704

INITiate:CONTinuous <state>

Parameters:

<state> ON | OFF | WAIT | RSTart

ON
Switches to the "continuous measurement" mode. Any continuous or single measurement that is already active is terminated. A new continuous measurement is started. This parameter changes the `INITiate` presetting to the "continuous" mode, i.e. every subsequent `INITiate` command (without parameter) starts a new continuous measurement and thus has the same effect as `INITiate:CONTinuous ON`. Identical to the START stroke. This command includes various reset functions: Resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement displays as well as the highlighting of the protocol analysis. Certain generator signals (burst signals, playback of WAV files by means of the Play function) are reset to the initial state. This command is recommended for continuous result reading.

OFF
Switches to the "single measurement" mode. Any in-progress continuous or single measurement is stopped. A new single measurement is started. This parameter changes the `INITiate` presetting to the "Single" mode, i.e. every subsequent `INITiate` command (without parameter) starts a new single measurement and thus has the same effect as `INITiate:CONTinuous OFF`. In the case of a stopped measurement or in-progress single measurement identical to the SINGLE stroke (during in-progress continuous measurement, the SINGLE stroke switches to single measurement without stopping the continuous measurement). Identical to `INITiate:FORCe SINGle`. This command does not involve reset functions, which means that the measurement is started several milliseconds faster. Recommended for single triggered measurements.

WAIT
`CONTinous` measurement in which the `SENSe<n1>:DATA<n2>` commands, which are used to query the measurement results, stop the IEC/IEEE bus until a measurement result is available.

RSTart
Resets the measurement or Play function and starts a single measurement or a sweep. it is identical to the START stroke.

Manual operation: See "START" on page 325
See "SINGLE" on page 325
See "START" on page 326
See "SINGLE" on page 326
See "START" on page 327
See "SINGLE" on page 327
See "START" on page 341
See "SINGLE" on page 341
See "START" on page 342
See "SINGLE" on page 342
See "START" on page 343
See "SINGLE" on page 343
See "START" on page 344
See "SINGLE" on page 344

INITiate:CONTinuous:TIMeout <timeout>

If timeout occurs without a new measurement result being available, the last measurement result that was read out is returned.

Parameters:

<timeout> 0 … 1000 s

0 s corresponds to the `INIT:CONT ON` setting.

INITiate:FORCe <force>

Parameters:

<force> STARt | STOP | SINGle | CONTinuous

STARt
Start of a continuous measurement.
Identical to the START stroke.
Identical to `INITiate:CONTinuous ON`; however, without changing the `INITiate` presetting.

STOP
Stops a measurement as if STOP/CONT was pressed while a measurement was in progress. (Identical to the `ABORt` command).

SINGle
Start of a single measurement.
In the case of a stopped measurement or an in-progress single measurement identical to the SINGLEstroke (during in-progress continuous measurement the SINGLE keystroke switches to single measurement without stopping the continuous measurement).
Identical to `INITiate:CONTinuous OFF`; however, without changing the `INITiate` presetting.

CONTinuous
Start of a continuous measurement; however, without reset function.
This retains the MIN/MAX values and limit violations, and measurement is started several milliseconds faster.

Manual operation:
See "STOP/CONT" on page 326
See "STOP/CONT" on page 327
See "STOP/CONT" on page 327
See "START" on page 341
See "SINGLE" on page 341
See "STOP/CONT" on page 341
See "START" on page 342
See "SINGLE" on page 342
See "STOP/CONT" on page 342
See "START" on page 343
See "SINGLE" on page 343
See "START" on page 344
See "SINGLE" on page 344

INITiate

Starts a measurement according to the mode preset by `INITiate:CONTinuous` (continuous or single measurement).

ABORt

Identical to `INITiate:FORCe STOP`.

Stops a measurement as if STOP/CONT was pressed while a measurement was in progress.

SENSe<n1>:REFerence<n2>:CHANnel <channel>

Parameters:
<channel> OFF | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8

Manual operation: See "Ref Channel" on page 296
See "Ref Channel" on page 317
See "Ref Channel" on page 329

TRIGger:CHANnel <channel>

Parameters:
<channel> OFF | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8

Manual operation: See "Trigger Chan" on page 296
See "Trigger Chan" on page 318
See "Trigger Chan" on page 329
See "Trigger Chan" on page 411

TRIGger:COUNt <count>

Parameters:
<count> integer

Manual operation: See "Points" on page 335

TRIGger:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Delay" on page 297
See "Delay" on page 319
See "Delay" on page 334

TRIGger:FREQuency:VARiation <variation>

Parameters:
<variation> float

Manual operation: See "Variation" on page 338

TRIGger:SOURce <source>

Parameters:

<source> AUTO | IMMediate | TIMer | CH1Freq | CH2Freq | CH1Level | CH2Level | CH1Trigger | CH2Trigger | TCHart | CH1Rapidfreq | CH2Rapidfreq | CH1Edgetrigger | CH2Edgetrigger | FREQuency | RAPidfreq | LEVel | TRIGger | EDGetrigger

Manual operation: See "Start Cond" on page 297
See "Start Cond" on page 318
See "Start Cond" on page 330

TRIGger:TIMer <timer>

Parameters:

<timer> float

Manual operation: See "Time" on page 335

TRIGger:VOLTage:VARiation <variation>

Parameters:

<variation> float

Manual operation: See "Variation" on page 338

7.5.2 External Sweeps and Level-Controlled Measurement Value Triggering

The following commands control the start conditions for external sweeps and level-controlled measurement value triggering (see also chapter 5.19, "External Sweeps and Level-Controlled Measured value Triggering", on page 336.

- `ARM:FREQuency:STARt` on page 704
- `ARM:FREQuency:STOP` on page 705
- `ARM:LEVel:MIN` on page 705
- `ARM:VOLTage:STARt` on page 705
- `ARM:VOLTage:STOP` on page 705
- `TRIGger:FREQuency:VARiation` on page 703
- `TRIGger:VOLTage:VARiation` on page 704

ARM:FREQuency:STARt <start>

Parameters:

<start> float

Manual operation: See "Start" on page 337

ARM:FREQuency:STOP <stop>

Parameters:
<stop> float

Manual operation: See "Stop" on page 338

ARM:LEVel:MIN <min>

Parameters:
<min> float

Manual operation: See "Min Volt" on page 337

ARM:VOLTage:STARt <start>

Parameters:
<start> float

Manual operation: See "Start" on page 337

ARM:VOLTage:STOP <stop>

Parameters:
<stop> float

Manual operation: See "Stop" on page 338

7.5.3 Reading Measurement Results

Depending on the measurements activated in the Analyzer panel, the Audio Analyzer indicates up to eight results in the numeric display in the case of a two-channel instrument and up to 64 results in the case of a multichannel instrument. The results are also available in buffers from where they can be read by remote control.

- `SENSe<n1>:DATA<n2>?` on page 705
- `SENSe<n1>:DATA<n2>:ALL?` on page 707

SENSe<n1>:DATA<n2>? <data>

The command retrieves the selected measurement result of the selected channel. The type of measurement is defined by suffix <n1>, the channel by suffix <n2> (for suffix range see below).

The figure below shows the assignment of remote control commands to the results indicated in the numeric display for an 8-channel analyzer.

For reasons of compatibility with the R&S UPL, in dual-measurement mode, a phase- or group-delay measurement result can be retrieved with `SENS4:DATA?` in addition to command `SENS3:DATA2?`.

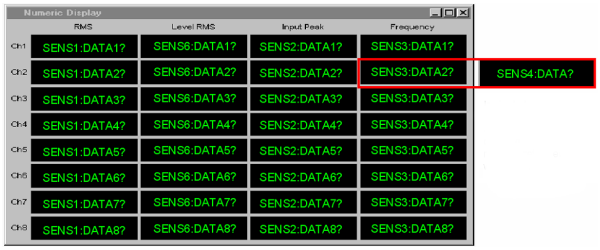


Fig. 7-1: Numeric Display and associated remote control commands

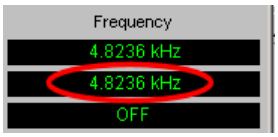
The query with `MIN` and `MAX` indicates the minimum and maximum measured value shown in the combi display above the measured value.

The return value comes in the basic unit (without engineering), e.g. a measurement result of 1.2345 kHzis returned as 1234.5 (Hz), a measurement result of 12.345 µV as 12.345e-006 (V).

If the measurement result of an overranged channel is requested with the `SENSe<n1>:DATA<n2>?` command, the value "3.40282346639e+038" (represents NaN = Not a Number) is returned.

Example

Display of channel 2's current frequency measurement result in the numeric display.



Display of channel 2's current frequency measurement result in the combined display with minimum and maximum values.

Parameters:

<data> float

Example: Reads out the current frequency measurement result and the respective `MIN`/`MAX` values from channel 2, see example above for grahical respresentation:

```
SENS3:DATA2?
```
Response: `4823.6 Hz`
```
SENS3:DATA2? MIN
```
Response: `1000 Hz`
```
SENS3:DATA2? MAX
```
Response: `20000 Hz`

Usage: Query only

SENSe<n1>:DATA<n2>:ALL? <all>

Returns the measurement results of `all` channels in the form of float values which are separated by a comma. Channels which are switched off are represented by value "9.91E+37".

Dual channel instruments: 2 channels

Multi channel instruments: 1 to 8 channels

Suffix:

<n1> 1 | 2 | 3 | 6
1 = function measurement results
2 = input peak measurement results
3 = frequency , phase measurement results
6 = level monitor measurement results

Parameters:

<all> float, float , float

Example:

```
INIT:CONT OFF; *WAI
SENS1:DATA:ALL?
```

Response:

```
1.0006 V,9.91E+37,1.00057 V,9.91E+37,1.00051
V,9.91E+37,9.91E+37,1.00051 V
```

Example:

```
INIT:CONT OFF; *WAI
SENS3:DATA:ALL?
```

Response:

```
1000 HZ,9.91E+37,-0.00248114
DEG,9.91E+37,0.00565384
DEG,9.91E+37,9.91E+37,0.0115933 DEG
```

A query with `MIN` or `MAX` returns all stored minimum and maximum measurement results.

Usage: Query only

7.5.4 Output of Trace Data Sets

The commands are grouped for the following subsystems according to their function:

| `SWEepFFT` | `BARGraph` | `WAVEform`

The value range for suffix <n2> depends on the subsystem:

For the Subsystem Sweep:	<n2> = 1 ... 4
For the Subsystem FFT:	<n2> = 1 | 2
For the Subsystem BARGraph:	<n2> = 1 | 2
For the Subsystems WAVeform:	<n2> = 1

- `DISPlay:BARGraph<n2>:SCANoffset` on page 710

- DISPlay:FFT<n2>:SCANoffset on page 710
- DISPlay:SWEep<n2>:SCANoffset on page 710
- DISPlay:WAVeform<n2>:SCANoffset on page 710
- FORMat on page 710
- TRACe:BARGraph<n2>:LDList:AX? on page 715
- TRACe:BARGraph<n2>:LDList:AY? on page 715
- TRACe:BARGraph<n2>:LDList:BX? on page 715
- TRACe:BARGraph<n2>:LDList:BY? on page 715
- TRACe:BARGraph<n2>:LDList:COUNt:AX? on page 716
- TRACe:BARGraph<n2>:LDList:COUNt:AY? on page 716
- TRACe:BARGraph<n2>:LDList:COUNt:BX? on page 716
- TRACe:BARGraph<n2>:LDList:COUNt:BY? on page 716
- TRACe:BARGraph<n2>:LOAD:AX? on page 713
- TRACe:BARGraph<n2>:LOAD:AY? on page 713
- TRACe:BARGraph<n2>:LOAD:BX? on page 713
- TRACe:BARGraph<n2>:LOAD:BY? on page 713
- TRACe:BARGraph<n2>:LOAD:COUNt:AX? on page 713
- TRACe:BARGraph<n2>:LOAD:COUNt:AY? on page 713
- TRACe:BARGraph<n2>:LOAD:COUNt:BX? on page 713
- TRACe:BARGraph<n2>:LOAD:COUNt:BY? on page 713
- DISPlay:BARGraph<n2>:SCANoffset on page 710
- TRACe:BARGraph<n2>:STORe:AY on page 788
- TRACe:BARGraph<n2>:STORe:BY on page 788
- TRACe:FFT<n2>:LDList:AX? on page 714
- TRACe:FFT<n2>:LDList:AY? on page 714
- TRACe:FFT<n2>:LDList:BX? on page 714
- TRACe:FFT<n2>:LDList:BY? on page 714
- TRACe:FFT<n2>:LDList:COUNt:AX? on page 714
- TRACe:FFT<n2>:LDList:COUNt:AY? on page 714
- TRACe:FFT<n2>:LDList:COUNt:BX? on page 714
- TRACe:FFT<n2>:LDList:COUNt:BY? on page 714
- TRACe:FFT<n2>:LOAD:AX? on page 712
- TRACe:FFT<n2>:LOAD:AY? on page 712
- TRACe:FFT<n2>:LOAD:BX? on page 712
- TRACe:FFT<n2>:LOAD:BY? on page 712
- TRACe:FFT<n2>:LOAD:COUNt:AX? on page 712
- TRACe:FFT<n2>:LOAD:COUNt:AY? on page 712

- TRACe:FFT<n2>:LOAD:COUNt:BX? on page 712
- TRACe:FFT<n2>:LOAD:COUNt:BY? on page 712
- DISPlay:FFT<n2>:SCANoffset on page 710
- TRACe:FFT<n2>:STORe:AY on page 789
- TRACe:FFT<n2>:STORe:BY on page 789
- TRACe:SWEep<n2>:LDList:AX? on page 714
- TRACe:SWEep<n2>:LDList:AY? on page 714
- TRACe:SWEep<n2>:LDList:BX? on page 714
- TRACe:SWEep<n2>:LDList:BY? on page 714
- TRACe:SWEep<n2>:LDList:COUNt:AX? on page 714
- TRACe:SWEep<n2>:LDList:COUNt:AY? on page 714
- TRACe:SWEep<n2>:LDList:COUNt:BX? on page 714
- TRACe:SWEep<n2>:LDList:COUNt:BY? on page 714
- TRACe:SWEep<n2>:LOAD:AX? on page 711
- TRACe:SWEep<n2>:LOAD:AY? on page 711
- TRACe:SWEep<n2>:LOAD:BX? on page 711
- TRACe:SWEep<n2>:LOAD:BY? on page 711
- TRACe:SWEep<n2>:LOAD:COUNt:AX? on page 711
- TRACe:SWEep<n2>:LOAD:COUNt:AY? on page 711
- TRACe:SWEep<n2>:LOAD:COUNt:BX? on page 711
- TRACe:SWEep<n2>:LOAD:COUNt:BY? on page 711
- TRACe:SWEep<n2>:STORe:AX on page 788
- TRACe:SWEep<n2>:STORe:AY on page 788
- TRACe:SWEep<n2>:STORe:BX on page 788
- TRACe:SWEep<n2>:STORe:BY on page 788
- TRACe:WAVeform<n2>:LDList:AX? on page 715
- TRACe:WAVeform<n2>:LDList:AY? on page 715
- TRACe:WAVeform<n2>:LDList:BX? on page 715
- TRACe:WAVeform<n2>:LDList:BY? on page 715
- TRACe:WAVeform<n2>:LDList:COUNt:AX? on page 715
- TRACe:WAVeform<n2>:LDList:COUNt:AY? on page 715
- TRACe:WAVeform<n2>:LDList:COUNt:BX? on page 715
- TRACe:WAVeform<n2>:LDList:COUNt:BY? on page 715
- TRACe:WAVeform<n2>:LOAD:AX? on page 713
- TRACe:WAVeform<n2>:LOAD:AY? on page 713
- TRACe:WAVeform<n2>:LOAD:BX? on page 713
- TRACe:WAVeform<n2>:LOAD:BY? on page 713

- TRACe:WAVeform<n2>:LOAD:COUNt:AX? on page 713
- TRACe:WAVeform<n2>:LOAD:COUNt:AY? on page 713
- TRACe:WAVeform<n2>:LOAD:COUNt:BX? on page 713
- TRACe:WAVeform<n2>:LOAD:COUNt:BY? on page 713
- DISPlay:WAVeform<n2>:SCANoffset on page 710
- TRACe:WAVeform<n2>:STORe:AY on page 789
- TRACe:WAVeform<n2>:STORe:BY on page 789

FORMat <format>

Defines the number format for outputting trace data sets.

This setting is not stored in the setup and is set to ASCII each time the R&S UPP is switched on.

Parameters:

<format> REAL | ASCii

REAL
Binary form!
The trace data sets are returned in binary format.
The binary data block has the following structure:
#<lengthofLength><Length><block_data>.
e.g. #234<block_data>
always introduces the binary block
<lengthofLength> indicates how many positions the following length specification occupies (2 in example)
<Length> indicates the number of subsequent bytes (34 in example)
<binary block data> binary block data of specified length

ASCii
Output as an ASCII string, digits with sign, decimal point and any exponent, e.g.
-57.1647,-6.08881,-32.304,-53.6429 …

DISPlay:BARGraph<n2>:SCANoffset <scanoffset>
DISPlay:FFT<n2>:SCANoffset <scanoffset>
DISPlay:WAVeform<n2>:SCANoffset <scanoffset>
DISPlay:SWEep<n2>:SCANoffset <scanoffset>

Defines the desired scan for outputting trace data sets.

Suffix:

<n2> The range of suffix <n2> varies depending on the subsystem, see chapter 7.5.4, "Output of Trace Data Sets", on page 707

Parameters:

<scanoffset> 2, 1, 0, -1 to -19

2
max scan

1
min scan

0
latest scan

-1 bis -19
the more negative the number, the older the scan.

Example: "DISP:SWE:SCAN 2
Selects max scan for output

Manual operation: See "Scan" on page 536

TRACe:SWEep<n2>:LOAD:AX?
TRACe:SWEep<n2>:LOAD:AY?
TRACe:SWEep<n2>:LOAD:BX?
TRACe:SWEep<n2>:LOAD:BY?
TRACe:SWEep<n2>:LOAD:COUNt:AX?
TRACe:SWEep<n2>:LOAD:COUNt:AY?
TRACe:SWEep<n2>:LOAD:COUNt:BX?
TRACe:SWEep<n2>:LOAD:COUNt:BY?

Command for outputting sweep trace data sets, see (see TRACe:SWEep<n2>:STORe:BY on page 788) and outputting the number of sweep data.

The following description shows the basic structure for command groups:

TRACe:Subsys<n2>:LOAD:..

TRACe:Subsys<n2>:LOAD:COUNt:.. and

TRACe:Subsys<n2>:LDList:.. and

TRACe:Subsys<n2>:LDList:COUNt:..

AX designates the X-axis of trace A

AY designates the Y-axis of trace A

BX designates the X-axis of trace B

BY designates the Y-axis of trace B

In the case of a multiscan display or single display with min/max traces, the command DISPlay:SWEep<n2>:SCANoffset on page 710 selects the desired scan.

The first example queries the sweep data, the second queries the number of data.

Suffix:

<n2> 1 ... 4
subsystems 1 to 4

Return values:

<argument> integer | float | binary

For the `COUNt` commands, an integer value is returned.
The format of the return values of the other commands depends on the `FORMat` setting:
If `FORMat ASCii` is selected float values are returned.
If `FORMat REAL` is selected a binary data block is returned.

Example:

First example:
`TRAC:SWEep1:LOAD:AY?`
Outputs the data of the Y-axis of channel A from the first sweep system.
Response with the setting `FORMat ASC`:
`-57.1647,-6.08881,-32.304,-53.6429 …`
Response with the setting `FORMat REAL`:
#<Lengthoflength><length><block_data>
Second example
`TRACe:SWEep1:LOAD:COUNt:BY?`
Outputs the number of data of the Y-axis of channel B from the first sweep subsystem
Response:
`50`

Usage: Query only

TRACe:FFT<n2>:LOAD:AX?
TRACe:FFT<n2>:LOAD:AY?
TRACe:FFT<n2>:LOAD:BX?
TRACe:FFT<n2>:LOAD:BY?
TRACe:FFT<n2>:LOAD:COUNt:AX?
TRACe:FFT<n2>:LOAD:COUNt:AY?
TRACe:FFT<n2>:LOAD:COUNt:BX?
TRACe:FFT<n2>:LOAD:COUNt:BY?

Commands for outputting FFT data and outputting the number of FFT data. See also `TRACe:SWEep<n2>:LOAD:COUNt:BY?` on page 711.

Suffix:

<n2> 1 | 2
subsystems 1 and 2

Return values:

<argument> integer | float | binary

For the `COUNt` commands, an integer value is returned.
The format of the return values of the other commands depends on the `FORMat` setting:
If `FORMat ASCii` is selected float values are returned.
If `FORMat REAL` is selected a binary data block is returned.

Usage: Query only

TRACe:WAVeform<n2>:LOAD:AX?
TRACe:WAVeform<n2>:LOAD:AY?
TRACe:WAVeform<n2>:LOAD:BX?
TRACe:WAVeform<n2>:LOAD:BY?
TRACe:WAVeform<n2>:LOAD:COUNt:AX?
TRACe:WAVeform<n2>:LOAD:COUNt:AY?
TRACe:WAVeform<n2>:LOAD:COUNt:BX?
TRACe:WAVeform<n2>:LOAD:COUNt:BY?

Commands for outputting Waveform data and outputting the number of Waveform data. See also TRACe:SWEep<n2>:LOAD:COUNt:BY? on page 711.

Suffix:
<n2> 1
subsystem 1

Return values:
<argument> integer | float | binary
For the COUNt commands, an integer value is returned.
The format of the return values of the other commands depends on the FORMat setting:
If FORMat ASCii is selected float values are returned.
If FORMat REAL is selected a binary data block is returned.

Usage: Query only

TRACe:BARGraph<n2>:LOAD:AX?
TRACe:BARGraph<n2>:LOAD:AY?
TRACe:BARGraph<n2>:LOAD:BX?
TRACe:BARGraph<n2>:LOAD:BY?
TRACe:BARGraph<n2>:LOAD:COUNt:AX?
TRACe:BARGraph<n2>:LOAD:COUNt:AY?
TRACe:BARGraph<n2>:LOAD:COUNt:BX?
TRACe:BARGraph<n2>:LOAD:COUNt:BY?

Commands for outputting bargraph trace data sets and outputting the number of bargraph data. See also TRACe:SWEep<n2>:LOAD:COUNt:BY? on page 711.

Suffix:
<n2> 1 | 2
subsystems 1 and 2

Return values:
<argument> integer | float | binary
For the COUNt commands, an integer value is returned.
The format of the return values of the other commands depends on the FORMat setting:
If FORMat ASCii is selected float values are returned.
If FORMat REAL is selected a binary data block is returned.

Usage: Query only

TRACe:SWEep<n2>:LDList:AX?
TRACe:SWEep<n2>:LDList:AY?
TRACe:SWEep<n2>:LDList:BX?
TRACe:SWEep<n2>:LDList:BY?
TRACe:SWEep<n2>:LDList:COUNt:AX?
TRACe:SWEep<n2>:LDList:COUNt:AY?
TRACe:SWEep<n2>:LDList:COUNt:BX?
TRACe:SWEep<n2>:LDList:COUNt:BY?

The `TRACe:SWEep<n2>:LDList:...` commands are basically identical to the `TRACe:SWEep<n2>:LOAD:...` commands, see `TRACe:SWEep<n2>:LOAD:BY?` on page 711.

They query the data records of filtered trace data and their number.

The filtering of the trace data is performed with command `DISPlay:SWEep<n2>:DLISt:FILTer ALL | LIMUpper | LIMLower | LIMBoth | HARMonics | PEAKs`

Suffix:
<n2> 1 ... 4
subsystems 1 to 4

Return values:
<argument> integer | float | binary
For the `COUNt` commands, an integer value is returned.
The format of the return values of the other commands depends on the `FORMat` setting:
If `FORMat ASCii` is selected float values are returned.
If `FORMat REAL` is selected a binary data block is returned.

Usage: Query only

TRACe:FFT<n2>:LDList:AX?
TRACe:FFT<n2>:LDList:AY?
TRACe:FFT<n2>:LDList:BX?
TRACe:FFT<n2>:LDList:BY?
TRACe:FFT<n2>:LDList:COUNt:AX?
TRACe:FFT<n2>:LDList:COUNt:AY?
TRACe:FFT<n2>:LDList:COUNt:BX?
TRACe:FFT<n2>:LDList:COUNt:BY?

The `TRACe:FFT<n2>:LDList:...` commands are basically identical to the `TRACe:FFT<n2>:LOAD:...` commands, see`TRACe:FFT<n2>:LOAD:COUNt:BY?` on page 712.

They query the data records of filtered trace data and their number.

The filtering of the trace data is performed with command `DISPlay:FFT<n2>:DLISt:FILTer ALL | LIMUpper | LIMLower | LIMBoth | HARMonics | PEAKs`

Suffix:
<n2> 1 | 2
subsystems 1 and 2

Return values:
<argument> integer | float | binary
For the COUNt commands, an integer value is returned.
The format of the return values of the other commands depends on the FORMat setting:
If FORMat ASCii is selected float values are returned.
If FORMat REAL is selected a binary data block is returned.

Usage: Query only

TRACe:WAVeform<n2>:LDList:AX?
TRACe:WAVeform<n2>:LDList:AY?
TRACe:WAVeform<n2>:LDList:BX?
TRACe:WAVeform<n2>:LDList:BY?
TRACe:WAVeform<n2>:LDList:COUNt:AX?
TRACe:WAVeform<n2>:LDList:COUNt:AY?
TRACe:WAVeform<n2>:LDList:COUNt:BX?
TRACe:WAVeform<n2>:LDList:COUNt:BY?

The TRACe:WAVeform<n2>:LDList:... commands are basically identical to the TRACe:WAVeform<n2>:LOAD:... commands, see TRACe:WAVeform<n2>:LOAD:COUNt:BY? on page 713.

They query the data records of filtered trace data and their number.

The filtering of the trace data is performed with command DISPlay:WAVeform:DLISt:FILTer ALL | LIMUpper | LIMLower | LIMBoth | HARMonics | PEAKs

Suffix:
<n2> 1
subsystem 1

Return values:
<argument> integer | float | binary
For the COUNt commands, an integer value is returned.
The format of the return values of the other commands depends on the FORMat setting:
If FORMat ASCii is selected float values are returned.
If FORMat REAL is selected a binary data block is returned.

Usage: Query only

TRACe:BARGraph<n2>:LDList:AX?
TRACe:BARGraph<n2>:LDList:AY?
TRACe:BARGraph<n2>:LDList:BX?
TRACe:BARGraph<n2>:LDList:BY?

TRACe:BARGraph<n2>:LDList:COUNt:AX?
TRACe:BARGraph<n2>:LDList:COUNt:AY?
TRACe:BARGraph<n2>:LDList:COUNt:BX?
TRACe:BARGraph<n2>:LDList:COUNt:BY?

The `TRACe:BARGraph<n2>:LDList:...` commands are basically identical to the `TRACe:BARGraph<n2>:LOAD:...` commands, see `TRACe:BARGraph<n2>:LOAD:BY?` on page 713.

They query the data records of filtered trace data and their number.

The filtering of the trace data is performed with command `DISPlay:BARGraph:DLISt:FILTer ALL | LIMUpper | LIMLower | LIMBoth | HARMonics | PEAKs`

Suffix:
<n2> 1 | 2
subsystems 1 and 2

Return values:
<argument> integer | float | binary
For the `COUNt` commands, an integer value is returned.
The format of the return values of the other commands depends on the `FORMat` setting:
If `FORMat ASCii` is selected float values are returned.
If `FORMat REAL` is selected a binary data block is returned.

Usage: Query only

7.5.5 Reading out Multi-channel Records

The `DATA` commands are used to read out multi-channel records.

Only the traces which were available in the windows of the respective systems can be read out with the `TRACe` commands (see chapter 7.5.4, "Output of Trace Data Sets", on page 707).

That is not enough for the 8-channel version; that is why the traces for all channels switched on in the base unit can be read out with the `DATA` commands.

The `DATA` command tree is available for `SWEep` | `FFT` and `BARGraph` sub-systems.

The `DATA` command tree does not exist for the `WAVeform` sub-systems because this sub-system is designed with two channels. The `TRACe` commands from the previous chapter must be used to read out records from this sub-system.

- `DATA:BARGraph:COUNt:X<n4>?` on page 717
- `DATA:BARGraph:COUNt:Y<n4>?` on page 717
- `DATA:BARGraph:X<n3>?` on page 718
- `DATA:BARGraph:Y<n3>?` on page 718
- `DATA:FFT:COUNt:X<n4>?` on page 717
- `DATA:FFT:COUNt:Y<n4>?` on page 717

- DATA:FFT:X<n3>? on page 718
- DATA:FFT:Y<n3>? on page 718
- DATA:SWEep:COUNt:X<n4>? on page 717
- DATA:SWEep:COUNt:Y<n4>? on page 717
- DATA:SWEep:X<n3>? on page 718
- DATA:SWEep:Y<n3>? on page 718

DATA:FFT:COUNt:X<n4>?
DATA:BARGraph:COUNt:X<n4>?
DATA:SWEep:COUNt:X<n4>?

Commands for reading out the number of X axis values of a sweep, an FFT or a bar-graph

The example below is exemplary for the FFT and bar graph sub-systems.

Suffix:
<n4> A channel need not be specified for reading out as there is only **one** X axis for all channels. Specifying a channel is nonetheless accepted as long as it is within the valid range.

Return values:
<argument> integer

Example: `DATA:SWEep:COUNt:X?`
Reads out the number of X axis values from the sweep system.
Response:
`100`

Usage: Query only

DATA:FFT:COUNt:Y<n4>?
DATA:BARGraph:COUNt:Y<n4>?
DATA:SWEep:COUNt:Y<n4>?

Commands to read out the number of values on the Y axis of a sweep, an FFT or a BARGraph.

The example below is exemplary for the FFT and BARGraph sub-systems.

Suffix:
<n4> Channel 1 … 8

Return values:
<argument> integer

Example: `DATA:SWEep:COUNt:Y?`
Reads out the number of Y axis values from the sweep system.
Response:
`100`

Usage: Query only

DATA:FFT:X<n3>?
DATA:BARGraph:X<n3>?
DATA:SWEep:X<n3>?

Commands for reading out the X axis data of a sweep, an FFT or a bar graph.

The example below is exemplary for the FFT and bar graph sub-systems.

Suffix:
<n3> To read out the X axis there is no need to specify a channel, as there is only one X axis for all channels. Specifying a channel is nonetheless accepted as long as it is within the valid range.

Return values:
<argument> float values or block data

the format of the returned data depends on the setting of format with command `FORMat`.

Example: `DATA:SWEep:X?`
Reads out X axis data from the sweep system.
Response with the `FORMat ASCii` setting:
100,120.045,144.109,172.997,207.675,249.304,…
Response with the `FORMat REAL` setting:
#<Lengthof length><length><block_data>

Usage: Query only

DATA:FFT:Y<n3>?
DATA:BARGraph:Y<n3>?
DATA:SWEep:Y<n3>?

Commands for reading out the Y axis values of a SWEep, an FFT or a BARGraph for the specified channel.

The example below is exemplary for the FFT and BARGraph sub-systems.

Suffix:
<n3> Channel 1 … 8

Return values:
<argument> float value or block data

the format of the returned data depends on the setting of format with command `FORMat`.

Example: `DATA:SWEep:Y5?`
Reads out channel 5's Y axis data from the sweep system.
Response with the `FORMat ASCii` setting:
0.0110738,0.0146608,0.0189856,0.0240953,0.0300301,…
Response with the `FORMat REAL` setting:
#<Lengthof length><length><block_data>

Usage: Query only

7.6 Sweep Options

The sweep is controlled by commands in the INITiate subsystem.

- INITiate:CONTinuous on page 700
- INITiate:FORCe on page 702

7.7 Selecting Measurement and Mode

The measurement type and measurement mode is selected with the two SENSe-commands SENSe:FUNCtion and SENSe:FUNCtion:MMode.

In addition the more specific measurement mode commands SENSe:FUNCtion:APERture:MODE and SENSe:VOLTage:APERture are described.

- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:APERture:MODE on page 720
- SENSe<n1>:FUNCtion:MMODe on page 721
- SENSe<n1>:VOLTage:APERture on page 721

SENSe<n1>:FUNCtion <state>

specifies the measurement.

Important:

This command selects all function measurements and several other types of measurement, see below. The following description is valid for all types of measurements. See also chapter 5.15, "Starting Measurements", on page 322.

Suffix:

<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
3 = frequency, phase, or group delay measurement
6 = level monitor measurement
7 = waveform monitor
8 = protocol analysis

Parameters:

<state> string | OFF | IPEak | IPEAK | DC | RMS | RMSSelect | THD | THDNsndr | MDISt | DFD | FFT | POLarity | NOCTave | FREQuency | FQPHase | FQGRoupdelay | SFRequency | FQSamplefrequency | LRMS | ON | SN | LIPSync | BERT

`SENSe[1]`:
RMS, RMSSelect, IPEak|IPEAK, SN, THD, THDNsndr, MDISt, DFD, POLarity, FFT, LIPSync, BERT
`SENSe2`:
ON, OFF, IPEak
`SENSe3`:
ON, OFF, FREQuency, FQPHase, FQGRoupdelay, FQSample-frequency, SFRequency
`SENSe6`:
PEAK, DC, LRMS
`SENSe7`:
ON, OFF
`SENSe8`:
ON, OFF

Manual operation:
See "Stream Header" on page 316
See "Function " on page 388
See "Function " on page 390
See "Function " on page 400
See "Waveform " on page 409
See "Prot Analysis / Stream Header" on page 418
See "Freq Phase" on page 428
See "Input Monitor" on page 434
See "Level Monitor" on page 434

SENSe<n1>:FUNCtion:APERture:MODE <mode>

Parameters:

<mode> NARRow | MEDium | WIDE | AFASt | AUTO | FAST | SFASt | SLOW | VALue | GENTrack

Manual operation:
See "Meas Time" on page 347
See "Meas Time" on page 350
See "Meas Time" on page 365
See "Reject Bandw " on page 379
See "Meas Time" on page 391
See "Meas Time " on page 407
See "Meas Time" on page 424
See "Meas Time" on page 427

SENSe<n1>:FUNCtion:MMODe <mmode>

Parameters:

<mmode> DALL | DODD | DEVen | D2 | D3 | | D2_268 | D3_268 | D2_118 | D3_118 | SELectdi | THDN | SINad | SNDRatio | PPEak | NPEak | PTOPeak | PABSolute | NOISe | LSELectdi | LDEVen | LDODd | LDALI | LTHDn | LNOIse | STANdard | COMPressed | USAMple | RMS | OCT1 | OCT3 | OCT6 | OCT12 | OCT24 | CBANd | NARRow | WIDE

Manual operation: See "Meas Mode " on page 360
See "Meas Mode " on page 363
See "Meas Mode " on page 371
See "Meas Mode " on page 377
See "Meas Mode " on page 385
See "Meas Mode " on page 390

SENSe<n1>:VOLTage:APERture <aperture>

Parameters:

<aperture> float

Manual operation: See "Meas Time" on page 347
See "Meas Time" on page 350
See "Meas Time" on page 365
See "Meas Time" on page 391
See "Meas Time " on page 407
See "Meas Time" on page 424
See "Meas Time" on page 427

7.8 Level Measurements

The level measurement is configured using commands of the `SENSe` subsystem.

7.8.1 Filter Settings

- `SENSe<n1>:FILTer<n2>` on page 737

7.8.2 RMS and RMS Selective Measurement

- `MMEMory:LOAD:FREQuency:SLCFrequency` on page 722
- `SENSe<n1>:BANDwidth` on page 722
- `SENSe<n1>:BANDwidth:MODE` on page 722
- `SENSe<n1>:FREQuency` on page 722
- `SENSe<n1>:FREQuency:FACTor` on page 723

- SENSe<n1>:FREQuency:SELect on page 723
- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:APERture:MODE on page 720
- SENSe<n1>:SWEep:CONTrol on page 723
- SENSe<n1>:SWEep:POINts on page 723
- SENSe<n1>:SWEep:SPACing on page 723
- SENSe<n1>:SWEep:STARt on page 723
- SENSe<n1>:SWEep:STEP on page 723
- SENSe<n1>:SWEep:STOP on page 724
- SENSe<n1>:VOLTage:APERture on page 721
- SENSe<n1>:VOLTage:INTVtime on page 724
- SENSe<n1>:VOLTage:INTVtime:MODE on page 724

MMEMory:LOAD:FREQuency:SLCFrequency <filename>

Input of the file name for the list of band-pass / band-stop center frequencies (frequency sweep list). Only available for activated bandpass / band-stop list sweep.

Parameters:
<filename> string

Manual operation: See "File Name" on page 357

SENSe<n1>:BANDwidth <bandwidth>

Parameters:
<bandwidth> float

Manual operation: See "Bandwidth" on page 352

SENSe<n1>:BANDwidth:MODE <mode>

Parameters:
<mode> PPCT1 | PPCT3 | PTOCt | POCT12 | PFIX | SPCT1 | SPCT3 | STOCt | SOCT12 | SFIX | PFASt | SFASt

Manual operation: See "Bandwidth" on page 352

SENSe<n1>:FREQuency <frequency>

Parameters:
<frequency> float

Manual operation: See "Freq Mode" on page 357

SENSe<n1>:FREQuency:FACTor <factor>

Parameters:
<factor> float

Manual operation: See "Factor" on page 359

SENSe<n1>:FREQuency:SELect <select>

Parameters:
<select> CW | FIXed | GENTrack | CH1 | CH1Freq | CH2 | CH2Freq | AUToboth | REFFrequency

Manual operation: See "Freq Mode" on page 357

SENSe<n1>:SWEep:CONTrol <control>

Parameters:
<control> OFF | ASWeep | ALISt

Manual operation: See "Sweep Ctrl" on page 354

SENSe<n1>:SWEep:POINts <points>

Parameters:
<points> integer

Manual operation: See "Points" on page 356

SENSe<n1>:SWEep:SPACing <spacing>

Parameters:
<spacing> LINSteps | LOGSteps | LINPoints | LOGPoints

Manual operation: See "Spacing" on page 355

SENSe<n1>:SWEep:STARt <start>

Parameters:
<start> float

Manual operation: See "Start" on page 356

SENSe<n1>:SWEep:STEP <step>

Parameters:
<step> float

Manual operation: See "Step" on page 356

SENSe<n1>:SWEep:STOP <stop>

Parameters:
<stop> float

Manual operation: See "Stop" on page 356

SENSe<n1>:VOLTage:INTVtime <intvtime>

Parameters:
<intvtime> float

Manual operation: See "Intv Time" on page 360

SENSe<n1>:VOLTage:INTVtime:MODE <mode>

Parameters:
<mode> FAST | SFASt | SLOW | | VALue | OFF

Manual operation: See "Intv Time" on page 360

7.8.3 Peak Measurement

- SENSe<n1>:FUNCtion:FFT:SIZE on page 730
- SENSe<n1>:FILTer<n2> on page 737
- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:MMODe on page 721
- SENSe<n1>:FUNCtion:SETTling:MODE on page 736
- SENSe<n1>:FUNCtion:SNSequence on page 725
- SENSe<n1>:VOLTage:INTVtime on page 724
- SENSe<n1>:VOLTage:INTVtime:MODE on page 724

7.8.4 DC Voltage Measurement

- SENSe<n1>:FUNCtion on page 719

7.9 Signal-to-Noise Measurements

7.9.1 S/N Measurement Function

- SENSe<n1>:FILTer<n2> on page 737

- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:APERture:MODE on page 720
- SENSe<n1>:FUNCtion:DCSuppression on page 725
- SENSe<n1>:FUNCtion:MMODe on page 721
- SENSe<n1>:VOLTage:APERture on page 721

SENSe<n1>:FUNCtion:DCSuppression <dcsuppression>

Parameters:
<dcsuppression> ON | OFF

Manual operation: See "DC Suppress" on page 345
See "DC Suppress" on page 363
See "DC Suppress " on page 401

7.9.2 S/N Sequence in Level Measurements

SENSe<n1>:FUNCtion:SNSequence <snsequence>

Parameters:
<snsequence> ON | OFF

Manual operation: See "S/N Sequence" on page 367

7.10 Distortion Measurements

7.10.1 General Settings

- MMEMory:LOAD:IEQualize on page 725
- SENSe<n1>:FUNCtion:BARGraph on page 726
- SENSe<n1>:FUNCtion:FFT:STATe on page 726
- SENSe<n1>:FUNCtion:REFNment on page 726
- SENSe<n1>:VOLTage:EQUalize on page 726

MMEMory:LOAD:IEQualize <iequalize>

Parameters:
<iequalize> string

Manual operation: See "Equalizer " on page 368
See "Equalizer " on page 392
See "Equalizer " on page 402

SENSe<n1>:FUNCtion:BARGraph <bargraph>

Parameters:
<bargraph> ON | OFF

Manual operation: See "Bargraph " on page 369
See "Bargraph " on page 393

SENSe<n1>:FUNCtion:FFT:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Post FFT " on page 394
See "Post FFT " on page 398

SENSe<n1>:FUNCtion:REFNment <refnment>

Parameters:
<refnment> N1 | N2 | N4 | N8

Manual operation: See "Refinement" on page 374

SENSe<n1>:VOLTage:EQUalize <equalize>

Parameters:
<equalize> ON | OFF

Manual operation: See "Equalizer " on page 368
See "Equalizer " on page 392
See "Equalizer " on page 402

7.10.2 THD

- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:DISTortion<n3> on page 726
- SENSe<n1>:FUNCtion:MMODe on page 721
- SENSe<n1>:VOLTage:FUNDamental on page 727
- SENSe<n1>:VOLTage:FUNDamental:MODE on page 727

SENSe<n1>:FUNCtion:DISTortion<n3> <distortion>

Parameters:
<distortion> ON | OFF

Manual operation: See "Even Harmonics " on page 373
See "Odd Harmonics " on page 373

SENSe<n1>:VOLTage:FUNDamental <fundamental>

Parameters:
<fundamental> float

Manual operation: See "Fundamental " on page 373
See "Fundamental " on page 380

SENSe<n1>:VOLTage:FUNDamental:MODE <mode>

Parameters:
<mode> AUTO | GENTrack | SOURce | VALue | FIXed

Manual operation: See "Fundamental " on page 373
See "Fundamental " on page 380

7.10.3 THD+N / SINAD

- SENSe<n1>:FILTer<n2> on page 737
- SENSe<n1>:FREQuency:LIMit:LOWer on page 727
- SENSe<n1>:FREQuency:LIMit:UPPer on page 727
- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:APERture:MODE on page 720
- SENSe<n1>:FUNCtion:MMODe on page 721
- SENSe<n1>:THDN:REJection on page 728
- SENSe<n1>:VOLTage:FUNDamental on page 727
- SENSe<n1>:VOLTage:FUNDamental:MODE on page 727

SENSe<n1>:FREQuency:LIMit:LOWer <lower>

Parameters:
<lower> float

Manual operation: See "Frq Lim Low " on page 381
See "Frq Lim Low" on page 393
See "Freq Lim Low" on page 403

SENSe<n1>:FREQuency:LIMit:UPPer <upper>

Parameters:
<upper> float

Manual operation: See "Frq Lim Upp " on page 382
See "Frq Lim Upp" on page 393
See "Freq Lim Upp" on page 404

SENSe<n1>:THDN:REJection <rejection>

Parameters:
<rejection> NARRow | WIDE

Manual operation: See "Rejection " on page 378

7.10.4 MOD DIST

- SENSe<n1>:FUNCtion on page 719

7.10.5 DFD

- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:MMODe on page 721

7.11 Polarity Measurement

- SENSe<n1>:FUNCtion on page 719

7.12 FFT Analysis

The FFT analysis (Fast Fourier Transformation) allows the input signal to be displayed in the spectral range (frequency range).

- MMEMory:LOAD:IEQualize on page 725
- SENSe<n1>:CHANnel:DELay on page 729
- SENSe<n1>:FILTer<n2> on page 737
- SENSe<n1>:FREQuency:LIMit on page 729
- SENSe<n1>:FREQuency:LIMit:LOWer on page 727
- SENSe<n1>:FREQuency:LIMit:UPPer on page 727
- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:DCSuppression on page 725
- SENSe<n1>:FUNCtion:FFT:AVERage on page 729
- SENSe<n1>:FUNCtion:FFT:AVERage:MODE on page 729
- SENSe<n1>:FUNCtion:FFT:MTIMe? on page 729
- SENSe<n1>:FUNCtion:FFT:RESolution? on page 729
- SENSe<n1>:FUNCtion:FFT:SIZE on page 730
- SENSe<n1>:FUNCtion:FFT:STATe on page 726

- SENSe<n1>:FUNCtion:FFT:STARt? on page 730
- SENSe<n1>:FUNCtion:FFT:STOP? on page 730
- SENSe<n1>:FUNCtion:FFT:TRIGgered on page 730
- SENSe<n1>:FUNCtion:FFT:WINDow on page 730
- SENSe<n1>:VOLTage:EQUalize on page 726

SENSe<n1>:CHANnel:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Delay Ch1, Delay Ref Chan" on page 401

SENSe<n1>:FREQuency:LIMit <limit>

Parameters:
<limit> ON | OFF

Manual operation: See "Freq Limit" on page 403

SENSe<n1>:FUNCtion:FFT:AVERage <average>

Parameters:
<average> integer

Manual operation: See "Avg Count " on page 404

SENSe<n1>:FUNCtion:FFT:AVERage:MODE <mode>

Parameters:
<mode> OFF | NORMal | EXPonential

Manual operation: See "Avg Mode " on page 404

SENSe<n1>:FUNCtion:FFT:MTIMe?

Return values:
<argument> integer

Usage: Query only

Manual operation: See "Meas Time " on page 406

SENSe<n1>:FUNCtion:FFT:RESolution?

Return values:
<argument> float

Usage: Query only

Manual operation: See "Resolution " on page 406

SENSe<n1>:FUNCtion:FFT:SIZE <size>

Parameters:
<size> S512 | S1K | S2K | S4K | S8K | S16K | S32K | S64K | S128K | S256K

Manual operation: See "FFT Size " on page 394
See "FFT Size" on page 396

SENSe<n1>:FUNCtion:FFT:STARt?

Return values:
<argument> float

Usage: Query only

Manual operation: See "Start " on page 405

SENSe<n1>:FUNCtion:FFT:STOP?

Return values:
<argument> float

Usage: Query only

Manual operation: See "Stop " on page 405

SENSe<n1>:FUNCtion:FFT:TRIGgered <triggered>

Parameters:
<triggered> ON | OFF

Manual operation: See "triggered" on page 405

SENSe<n1>:FUNCtion:FFT:WINDow <window>

Parameters:
<window> RECTangular | HANN | HAMMing | BLACkman_harris | RIF1 | RIF2 | RIF3 | FLATtop

Manual operation: See "Window " on page 397

7.13 Delay Measurement

Delay measurement reqiures suffix 1 or no suffix at the `SENSe:...` commands.

- `SENSe3:FREQuency:APERture:MODE` on page 734
- `SENSe<n1>:FUNCtion` on page 719
- `SENSe<n1>:FUNCtion:REFTo` on page 731

- SENSe<n1>:LIPSync:AUDio:THReshold:LOW on page 734
- SENSe:LIPSync:AUDio:THReshold:HIGH on page 731

SENSe<n1>:FUNCtion:REFTo <refto>

Parameters:
<refto> TRGIn | REFCh

Manual operation: See "Refer to " on page 406

SENSe:LIPSync:AUDio:THReshold:HIGH <high>

Parameters:
<high> float

Manual operation: See "Auto Trigger Threshold High" on page 407

7.14 Analysis in the Time Domain

In addition to analysis in the frequency domain, the R&S UPP can also be used to analyze input signals in the time domain. Time and frequency-domain analyses can be performed simultaneously and irrespective of the selected measurement function.

SENSe7:FUNCtion:

Analysis in the time domain is selected by using suffix 7 at the SENSe7:FUNCtion command.

- SENSe7:CMPFactor on page 731
- SENSe<n1>:FUNCtion on page 719
- SENSe7:MMODe on page 732
- SENSe7:TRIGger:AUTO on page 732
- SENSe7:TRIGger:LEVel on page 732
- SENSe7:TRIGger:PRE on page 732
- SENSe7:TRIGger:SLOPe on page 732
- SENSe7:TRIGger:SOURce on page 732
- SENSe7:TRIGger:TRCLength on page 732

SENSe7:CMPFactor <cmpfactor>

Parameters:
<cmpfactor> integer

Manual operation: See "Comp Factor" on page 410

SENSe7:MMODe <mmode>

Parameters:
<mmode> STANdard | COMPressed | USAMple

Manual operation: See "Meas Mode " on page 409

SENSe7:TRIGger:AUTO <state>

Parameters:
<state> ON | OFF

Manual operation: See "Autotrigger" on page 414

SENSe7:TRIGger:LEVel <level>

Parameters:
<level> float

Manual operation: See "Trigger Level" on page 412

SENSe7:TRIGger:PRE <pre>

Parameters:
<pre> float

Manual operation: See "Pretrigger" on page 413

SENSe7:TRIGger:SLOPe <slope>

Parameters:
<slope> RISing | FALLing

Manual operation: See "Trigger Slope" on page 413

SENSe7:TRIGger:SOURce <source>

Parameters:
<source> CH1 | CH2 | MANual | GENBurst | TRGChannel

Manual operation: See "Trigger Source" on page 411

SENSe7:TRIGger:TRCLength <trclength>

Parameters:
<trclength> float

Manual operation: See "Trace Length" on page 410

7.15 Protocol Analysis

Protocol analysis is selected by using suffix 8 at the `SENSe8:FUNCtion` command.

- `SENSe<n1>:FUNCtion` on page 719
- `SENSe8:PROTocol:DISPlay` on page 733
- `SENSe8:PROTocol:MODE` on page 733
- `SENSe8:PROTocol:HIGHlight` on page 733
- `SENSe8:PROTocol:PERSistence` on page 733
- `SENSe8:PROTocol:VIEW` on page 733

SENSe8:PROTocol:DISPlay <display>

Parameters:
<display> ON | OFF

SENSe8:PROTocol:MODE <mode>

Parameters:
<mode> AUTomatic | CONSumer | PROFessional | FILE

Manual operation: See "Display Mode" on page 419

SENSe8:PROTocol:HIGHlight <highlight>

Parameters:
<highlight> NOTHing | FOUTput | BETWeen | FSTart

Manual operation: See "Highlight" on page 419

SENSe8:PROTocol:PERSistence <persistence>

Parameters:
<persistence> SHORt | LONG | FOREver

Manual operation: See "Persistence" on page 420

SENSe8:PROTocol:VIEW <view>

Parameters:
<view> BINText | BINOnly

Manual operation: See "View Mode" on page 420

7.16 Lip-Sync Analysis

Setting `LIPSync` at the `SENSe:FUNCtion` command selects the Lip-Sync analysis.

- SENSe<n1>:FUNCtion on page 719
- SENSe<n1>:FUNCtion:APERture:MODE on page 720
- SENSe<n1>:LIPSync:AUDio:THReshold:LOW on page 734
- SENSe<n1>:LIPSync:COLor:THReshold:HIGH:STRing on page 734
- SENSe<n1>:LIPSync:COLor:THReshold:LOW:STRing on page 734

SENSe<n1>:LIPSync:AUDio:THReshold:LOW <low>

Parameters:
<low> float

Manual operation: See "Auto Trigger Threshold Low" on page 407
See "Low" on page 426

SENSe<n1>:LIPSync:COLor:THReshold:HIGH:STRing <string>

Parameters:
<string> string

Manual operation: See "RGB string" on page 426

SENSe<n1>:LIPSync:COLor:THReshold:LOW:STRing <string>

Parameters:
<string> string

Manual operation: See "RGB string" on page 425

7.17 Frequency, Phase and Group Delay Measurement

SENSe3:...:

Frequency, phase and group delay measurement is selected by using suffix 3 at the SENSe3:... commands.

- SENSe3:FREQuency:APERture:MODE on page 734
- SENSe<n1>:FUNCtion on page 719
- SENSe3:PHASe:FORMat on page 735

SENSe3:FREQuency:APERture:MODE <mode>

Parameters:
<mode> PRECision | FAST

Manual operation: See "Meas Time" on page 431

SENSe3:PHASe:FORMat <format>

Parameters:

<format> POSitive | POSNegative | NEGative | RAD | RADBipolar | RADNegative | INFinite

Manual operation: See "Format Phase" on page 432

7.18 Input and Level Monitor

`SENSe2:...:`

Input monitor is selected by using suffix `2` at the `SENSe<n1>:FUNCtion` command.

`SENSe6:...:`

Level monitor is selected by using suffix `6` a t the `SENSe<n1>:FUNCtion` command.

- `SENSe<n1>:FUNCtion` on page 719

7.19 Settling Methods

The commands are assigned as follows:

- `SENSe:FUNCtion:...`
  Settling of the measurement function
- `SENSe:TRIGger:...`
  Settling of the start conditions (event-triggered measurements)
- `SENSe<n1>:FUNCtion:SETTling:COUNt` on page 735
- `SENSe<n1>:FUNCtion:SETTling:MODE` on page 736
- `SENSe<n1>:FUNCtion:SETTling:RESolution` on page 736
- `SENSe<n1>:FUNCtion:SETTling:TOLerance` on page 736
- `SENSe<n1>:FUNCtion:SETTling:TOUT` on page 0
- `SENSe<n1>:TRIGger:SETTling:COUNt` on page 735
- `SENSe<n1>:TRIGger:SETTling:MODE` on page 736
- `SENSe<n1>:TRIGger:SETTling:RESolution` on page 736
- `SENSe<n1>:TRIGger:SETTling:TOLerance` on page 736

SENSe<n1>:FUNCtion:SETTling:COUNt <count>
SENSe<n1>:TRIGger:SETTling:COUNt <count>

Parameters:

<count> integer

Manual operation: See "Samples" on page 442

SENSe<n1>:FUNCtion:SETTling:MODE <mode>
SENSe<n1>:TRIGger:SETTling:MODE <mode>
Parameters:
<mode> OFF | EXPonential | FLAT | AVERage

Manual operation: See "Settling" on page 441

SENSe<n1>:FUNCtion:SETTling:RESolution <resolution>
SENSe<n1>:TRIGger:SETTling:RESolution <resolution>
Parameters:
<resolution> float

Manual operation: See "Resolution" on page 442

SENSe<n1>:FUNCtion:SETTling:TOLerance <tolerance>
SENSe<n1>:TRIGger:SETTling:TOLerance <tolerance>
Parameters:
<tolerance> float

Manual operation: See "Tolerance" on page 442

SENSe<n1>:FUNCtion:SETTling:TOUT <tout>
Parameters:
<tout> float

Manual operation: See "Timeout" on page 440

7.20 Filters

The R&S UPP offers several position to switch on predefined filters:

- Analyzer pre-filter
  command `INPut:FILTer`
  This filter is inserted prior to the analysis functions.
- Analyzer function filter
  command`SENSe:FILTer<n2>`.
  Depending on the instrument and the active analyzer function, up to three filters can be connected in series. They are selected by suffix <n2>.
- Generator function filter
  - command `SOURce:FILTer`
    for several generator functions
  - command `SOURce:MCHannel<n2>:FILTer`
    for generator function "Universal".
  - command `SOURce:STEReo2:FILTer`
    for generator function "Stereo Sine".

The SENSe:UFILter command is used to configure user filters.The user defined filters can be used for the generator and analyzer functions.

- INPut<n1>:FILTer on page 737
- SENSe<n1>:FILTer<n2> on page 737
- SENSe<n1>:UFILter<n2> on page 738
- SENSe<n1>:UFILter<n2>:ATTenuation on page 738
- SENSe<n1>:UFILter<n2>:CENTer on page 738
- SENSe<n1>:UFILter<n2>:DELay on page 738
- SENSe<n1>:UFILter<n2>:FNAMe on page 738
- SENSe<n1>:UFILter<n2>:ORDer on page 739
- SENSe<n1>:UFILter<n2>:PASSb on page 739
- SENSe<n1>:UFILter<n2>:PASSb:LOWer on page 739
- SENSe<n1>:UFILter<n2>:PASSb:UPPer on page 739
- SENSe<n1>:UFILter<n2>:STOPb on page 739
- SENSe<n1>:UFILter<n2>:STOPb:LOWer on page 739
- SENSe<n1>:UFILter<n2>:STOPb:UPPer on page 739
- SENSe<n1>:UFILter<n2>:WIDTh on page 740
- SOURce:FILTer on page 740
- SOURce:MCHannel<n2>:FILTer on page 740
- SOURce:STEReo<n2>:FILTer on page 740

INPut<n1>:FILTer <filter>

see also chapter 5.36, "Filter", on page 444

Parameters:

<filter> OFF | UFIL1 | UFIL2 | UFIL3 | UFIL4 | UFIL5 | UFIL6 | UFIL7 | UFIL8 | UFIL9 | AWE | CARM | CCIU | CCIR | CCIT | CMES | DEMP17 | DCN | DEMP5015 | DEMP75 | IECT | JITT | PEMP17 | PEMP50 | PEMP5015 | PEMP75 | HP22 | HP400 | LP22 | LP30 | LP80 | AES17 | CWE | URUM | WRUM

Manual operation: See "Pre Filter" on page 292
See "Pre Filter" on page 299
See "Pre Filter" on page 306
See "Pre Filter" on page 317

SENSe<n1>:FILTer<n2> <filter>

Suffix:

<n2> Selects the number of filters looped into the measurement path, maximum is 2.

Parameters:
<filter> OFF | UFIL1 | UFIL2 | UFIL3 | UFIL4 | UFIL5 | UFIL6 | UFIL7 | UFIL8 | UFIL9 | AWE | CARM | CCIU | CCIR | CCIT | CMES | DEMP17 | DCN | DEMP5015 | DEMP75 | IECT | JITT | PEMP17 | PEMP50 | PEMP5015 | PEMP75 | HP22 | HP400 | LP22 | LP30 | LP80 | AES17 | CWE | URUM | WRUM

Manual operation: See "Filter" on page 346
See "Filter" on page 364
See "Filter" on page 380
See "Filter" on page 391
See "Filter" on page 402

SENSe<n1>:UFILter<n2> <ufilter>

Parameters:
<ufilter> HPASs | LPASs | BPASs | BSTop | BSTOp | NOTCh | TOCTave | FILE

Manual operation: See "Filters 01 to 09" on page 446

SENSe<n1>:UFILter<n2>:ATTenuation <attenuation>

Parameters:
<attenuation> float

Manual operation: See "Attenuation" on page 453

SENSe<n1>:UFILter<n2>:CENTer

Parameters:
 float

Manual operation: See "Center Freq" on page 450

SENSe<n1>:UFILter<n2>:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Delay" on page 453

SENSe<n1>:UFILter<n2>:FNAMe <fname>

Parameters:
<fname> string

Manual operation: See "File Def Filter" on page 451

SENSe<n1>:UFILter<n2>:ORDer <order>

Parameters:
<order> N4 | N8

Manual operation: See "Order" on page 447

SENSe<n1>:UFILter<n2>:PASSb <passb>

Parameters:
<passb> float

Manual operation: See "Passband" on page 448

SENSe<n1>:UFILter<n2>:PASSb:LOWer <lower>

Parameters:
<lower> float

Manual operation: See "Passb Low" on page 449

SENSe<n1>:UFILter<n2>:PASSb:UPPer <upper>

Parameters:
<upper> float

Manual operation: See "Passb Upp" on page 449

SENSe<n1>:UFILter<n2>:STOPb <stopb>

Parameters:
<stopb> float

Manual operation: See "Stopband" on page 448

SENSe<n1>:UFILter<n2>:STOPb:LOWer <lower>

Parameters:
<lower> float

Manual operation: See "Stopb Low" on page 449
See "Stopb Low" on page 451

SENSe<n1>:UFILter<n2>:STOPb:UPPer <upper>

Parameters:
<upper> float

Manual operation: See "Stopb Upp" on page 449
See "Stopb Upp" on page 451

SENSe<n1>:UFILter<n2>:WIDTh <width>

Parameters:
<width> float

Manual operation: See "Width" on page 451

SOURce:FILTer <filter>

Parameters:
<filter> OFF | UFIL1 | UFIL2 | UFIL3 | UFIL4 | UFIL5 | UFIL6 | UFIL7 | UFIL8 | UFIL9 | AWE | CARM | CCIU | CCIR | CCIT | CMES | DEMP17 | DCN | DEMP5015 | DEMP75 | IECT | JITT | PEMP17 | PEMP50 | PEMP5015 | PEMP75 | HP22 | HP400 | LP22 | LP30 | LP80 | AES17 | CWE | URUM | WRUM

Manual operation: See "Filter" on page 223
See "Filter / Filter Ch1" on page 227
See "Filter" on page 231
See "Filter" on page 233
See "Filter" on page 235
See "Filter" on page 238
See "Filter" on page 243
See "Filter" on page 245
See "Filter / Filter Ch1" on page 251

SOURce:MCHannel<n2>:FILTer <filter>

Parameters:
<filter> OFF | UFIL1 | UFIL2 | UFIL3 | UFIL4 | UFIL5 | UFIL6 | UFIL7 | UFIL8 | UFIL9 | AWE | CARM | CCIU | CCIR | CCIT | CMES | DEMP17 | DCN | DEMP5015 | DEMP75 | IECT | JITT | PEMP17 | PEMP50 | PEMP5015 | PEMP75 | HP22 | HP400 | LP22 | LP30 | LP80 | AES17 | CWE | URUM | WRUM

Manual operation: See "Filter" on page 259

SOURce:STEReo<n2>:FILTer <filter>

Suffix:
<n2> 1 | 2
1 = filter for channel 1 of generator function "Stereo Sine". Command `SOURce.STEReo1:FILTer` is an alias to command `SOURce:FILTer`.
2 = filter for channel 2 of generator function "Stereo Sine".

Parameters:
<filter> OFF | UFIL1 | UFIL2 | UFIL3 | UFIL4 | UFIL5 | UFIL6 | UFIL7 | UFIL8 | UFIL9 | AWE | CARM | CCIU | CCIR | CCIT | CMES | DEMP17 | DCN | DEMP5015 | DEMP75 | IECT | JITT | PEMP17 | PEMP50 | PEMP5015 | PEMP75 | HP22 | HP400 | LP22 | LP30 | LP80 | AES17 | CWE | URUM | WRUM

Manual operation: See "Filter Ch2" on page 227
See "Filter Ch2" on page 251

7.21 Audio Monitoring

The `AUXiliaries` subsystem controls the Audio Monitor.

- `AUXiliaries:AUDMonitor` on page 741
- `AUXiliaries:SIGSource` on page 741
- `AUXiliaries:SPEaker:MONitor<n3>` on page 741
- `AUXiliaries:SPEaker:SOURce<n3>` on page 742
- `AUXiliaries:SPEaker:VOLume<n3>` on page 742
- `AUXiliaries:TRIGger:OUTPut:DELay` on page 742
- `AUXiliaries:TRIGger:OUTPut:ENABle` on page 742
- `AUXiliaries:TRIGger:OUTPut:MODE` on page 742
- `AUXiliaries:VOLTage<n2>` on page 742

AUXiliaries:AUDMonitor <audmonitor>

Parameters:
<audmonitor> ON | OFF

Manual operation: See "Audio Monitor " on page 462

AUXiliaries:SIGSource <sigsource>

Parameters:
<sigsource> TRACk | SPLit

Manual operation: See "Signal Source" on page 462

AUXiliaries:SPEaker:MONitor<n3> <monitor>

Parameters:
<monitor> OFF | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8

Manual operation: See "Monitor 1, Monitor 2 " on page 463

AUXiliaries:SPEaker:SOURce<n3> <source>

Parameters:
<source> INPut | FUNCtion | DC

Manual operation: See "Signal Source, Sig Source 1, Sig Source 2" on page 462

AUXiliaries:SPEaker:VOLume<n3> <volume>

Parameters:
<volume> integer

Manual operation: See "Volume, Volume 1, Volume 2 " on page 464

AUXiliaries:TRIGger:OUTPut:DELay <delay>

Parameters:
<delay> float

Manual operation: See "Mode" on page 465

AUXiliaries:TRIGger:OUTPut:ENABle <enable>

Parameters:
<enable> ON | OFF

Manual operation: See "Enable" on page 464

AUXiliaries:TRIGger:OUTPut:MODE <mode>

Parameters:
<mode> | CASCade | GENSync

Manual operation: See "Mode" on page 465

AUXiliaries:VOLTage<n2> <voltage>

Parameters:
<voltage> float

Manual operation: See "Voltage Ch 1, Voltage Ch 2 " on page 463

7.22 Switcher

The following commands control the R&S UPZ Audio Switcher. For further information see the operating manual for the R&S UPZ.

- `SWITcher:COMPort` on page 743
- `SWITcher:INPA` on page 743

- SWITcher:INPB on page 743
- SWITcher:OFFSet:BVSA on page 743
- SWITcher:OFFSet:OVSI on page 743
- SWITcher:OUTA on page 743
- SWITcher:OUTB on page 744
- SWITcher:STATe on page 744
- SWITcher:TRACking on page 744

SWITcher:COMPort <comport>

Parameters:
<comport> selection
COM3 | COM4 | COM5 | COM6 | AUTO

Manual operation: See "COM Port" on page 466

SWITcher:INPA <inpa>

Parameters:
<inpa> integer

Manual operation: See "Input A" on page 469

SWITcher:INPB <inpb>

Parameters:
<inpb> integer

Manual operation: See "Input B" on page 469

SWITcher:OFFSet:BVSA <bvsa>

Parameters:
<bvsa> integer

Manual operation: See "B vs A" on page 468

SWITcher:OFFSet:OVSI <ovsi>

Parameters:
<ovsi> integer

Manual operation: See "Out vs Inp" on page 469

SWITcher:OUTA <outa>

Parameters:
<outa> integer

Manual operation: See "Output A" on page 469

SWITcher:OUTB <outb>

Parameters:
<outb> integer

Manual operation: See "Output B" on page 469

SWITcher:STATe <state>

Parameters:
<state> ON | OFF

Manual operation: See "Switcher" on page 468

SWITcher:TRACking <tracking>

Parameters:
<tracking> OFF | BVSA | OVSI | ALL

Manual operation: See "Tracking" on page 468

7.23 Traces, Spectrum Displays and Bargraphs

7.23.1 Display Configuration

The commands are grouped for the following subsystems according to their function:

`FFT` | `WAVEform` | `BARGraph` | `SWEep`

The value range for suffix <n2> depends on the subsystem:

For the Subsystem Sweep:	<n2> = 1 … 4
For the Subsystem FFT:	<n2> = 1 | 2
For the Subsystem BARGraph:	<n2> = 1 | 2
For the Subsystems WAVeform:	<n2> = 1

- `DISPlay:BARGraph<n2>:A:BOTTom` on page 753
- `DISPlay:BARGraph<n2>:A:CHANnel` on page 754
- `DISPlay:BARGraph<n2>:A:LABel:AUTO` on page 754
- `DISPlay:BARGraph<n2>:A:LABel:USER` on page 754
- `DISPlay:BARGraph<n2>:A:LEGend:DESCription` on page 754
- `DISPlay:BARGraph<n2>:A:LEGend:SHOW` on page 755

- DISPlay:BARGraph<n2>:A:LIMLower on page 755
- DISPlay:BARGraph<n2>:A:LIMLower:SOURce on page 755
- DISPlay:BARGraph<n2>:A:LIMLower:SOURce:FILE on page 756
- DISPlay:BARGraph<n2>:A:LIMLower:SOURce:VALue on page 756
- DISPlay:BARGraph<n2>:A:LIMShift on page 756
- DISPlay:BARGraph<n2>:A:LIMShift:PARallel on page 756
- DISPlay:BARGraph<n2>:A:LIMShift:SYMMetrical on page 757
- DISPlay:BARGraph<n2>:A:LIMUpper on page 757
- DISPlay:BARGraph<n2>:A:LIMUpper:SOURce on page 757
- DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:FILE on page 758
- DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:VALue on page 758
- DISPlay:BARGraph<n2>:A:NORMalize on page 758
- DISPlay:BARGraph<n2>:A:NORMalize:VALue on page 758
- DISPlay:BARGraph<n2>:A:REFerence on page 759
- DISPlay:BARGraph<n2>:A:REFerence:FILE on page 759
- DISPlay:BARGraph<n2>:A:REFerence:VALue on page 759
- DISPlay:BARGraph<n2>:A:SPACing on page 759
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- DISPlay:WAVeform<n2>:X:LABel:USER on page 765
- DISPlay:WAVeform<n2>:X:LEFT on page 765
- DISPlay:WAVeform<n2>:X:REFerence:VALue on page 765
- DISPlay:WAVeform<n2>:X:RIGHt on page 765

- DISPlay:WAVeform<n2>:X:SCALing on page 766
- DISPlay:WAVeform<n2>:X:SPACing on page 766
- DISPlay:WAVeform<n2>:X:UNIT on page 766
- DISPlay:WAVeform<n2>:X:UNIT:AUTO on page 766
- DISPlay:WAVeform<n2>:X:UNIT:USER on page 766
- MMEMory:BARGraph<n2>:LIMit:OFFSet on page 767
- MMEMory:BARGraph<n2>:LIMit:OFFSet:VALue on page 767
- MMEMory:BARGraph<n2>:STAS on page 767
- MMEMory:BARGraph<n2>:STORe on page 768
- MMEMory:BARGraph<n2>:TRACe on page 768
- MMEMory:FFT<n2>:EQUalization:INVert on page 767
- MMEMory:FFT<n2>:EQUalization:MODify on page 767
- MMEMory:FFT<n2>:EQUalization:NORMfrequency on page 767
- MMEMory:FFT<n2>:LIMit:OFFSet on page 767
- MMEMory:FFT<n2>:LIMit:OFFSet:VALue on page 767
- MMEMory:FFT<n2>:STAS on page 767
- MMEMory:FFT<n2>:STORe on page 768
- MMEMory:FFT<n2>:TRACe on page 768
- MMEMory:SWEep<n2>:EQUalization:INVert on page 767
- MMEMory:SWEep<n2>:EQUalization:MODify on page 767
- MMEMory:SWEep<n2>:EQUalization:NORMfrequency on page 767
- MMEMory:SWEep<n2>:LIMit:OFFSet on page 767
- MMEMory:SWEep<n2>:LIMit:OFFSet:VALue on page 767
- MMEMory:SWEep<n2>:STAS on page 767
- MMEMory:SWEep<n2>:STORe on page 768
- MMEMory:SWEep<n2>:TRACe on page 768
- MMEMory:WAVeform<n2>:STAS on page 767
- MMEMory:WAVeform<n2>:STORe on page 768
- SENSe<n1>:CONFig:COPYother on page 768

DISPlay:FFT<n2>:A:BOTTom <bottom>
DISPlay:FFT<n2>:B:BOTTom <bottom>
DISPlay:WAVeform<n2>:A:BOTTom <bottom>
DISPlay:WAVeform<n2>:B:BOTTom <bottom>
DISPlay:BARGraph<n2>:A:BOTTom <bottom>
DISPlay:BARGraph<n2>:B:BOTTom <bottom>
DISPlay:SWEep<n2>:A:BOTTom <bottom>
DISPlay:SWEep<n2>:B:BOTTom <bottom>
Parameters:
<bottom> float

Manual operation: See "Bottom" on page 510

DISPlay:FFT<n2>:A:CHANnel <channel>
DISPlay:FFT<n2>:B:CHANnel <channel>
DISPlay:WAVeform<n2>:A:CHANnel <channel>
DISPlay:WAVeform<n2>:B:CHANnel <channel>
DISPlay:BARGraph<n2>:A:CHANnel <channel>
DISPlay:BARGraph<n2>:B:CHANnel <channel>
DISPlay:SWEep<n2>:A:CHANnel <channel>
DISPlay:SWEep<n2>:B:CHANnel <channel>
Parameters:
<channel> OFF | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8

Manual operation: See "Channel" on page 497

DISPlay:FFT<n2>:A:LABel:AUTO <state>
DISPlay:FFT<n2>:B:LABel:AUTO <state>
DISPlay:WAVeform<n2>:A:LABel:AUTO <state>
DISPlay:WAVeform<n2>:B:LABel:AUTO <state>
DISPlay:BARGraph<n2>:A:LABel:AUTO <state>
DISPlay:BARGraph<n2>:B:LABel:AUTO <state>
DISPlay:SWEep<n2>:A:LABel:AUTO <state>
DISPlay:SWEep<n2>:B:LABel:AUTO <state>
Parameters:
<state> ON | OFF

Manual operation: See "Label Auto" on page 498

DISPlay:FFT<n2>:A:LABel:USER <user>
DISPlay:FFT<n2>:B:LABel:USER <user>
DISPlay:WAVeform<n2>:A:LABel:USER <user>
DISPlay:WAVeform<n2>:B:LABel:USER <user>
DISPlay:BARGraph<n2>:A:LABel:USER <user>
DISPlay:BARGraph<n2>:B:LABel:USER <user>
DISPlay:SWEep<n2>:A:LABel:USER <user>
DISPlay:SWEep<n2>:B:LABel:USER <user>
Parameters:
<user> string

Manual operation: See "Label Auto" on page 498

DISPlay:FFT<n2>:A:LEGend:DESCription <description>
DISPlay:FFT<n2>:B:LEGend:DESCription <description>
DISPlay:WAVeform<n2>:A:LEGend:DESCription <description>
DISPlay:WAVeform<n2>:B:LEGend:DESCription <description>
DISPlay:BARGraph<n2>:A:LEGend:DESCription <description>
DISPlay:BARGraph<n2>:B:LEGend:DESCription <description>

DISPlay:SWEep<n2>:A:LEGend:DESCription <description>
DISPlay:SWEep<n2>:B:LEGend:DESCription <description>
Parameters:
<description> string

Manual operation: See "Title Descript, Leg A Descript, Leg B Descript" on page 530

DISPlay:FFT<n2>:A:LEGend:SHOW <state>
DISPlay:FFT<n2>:B:LEGend:SHOW <state>
DISPlay:WAVeform<n2>:A:LEGend:SHOW <state>
DISPlay:WAVeform<n2>:B:LEGend:SHOW <state>
DISPlay:BARGraph<n2>:A:LEGend:SHOW <state>
DISPlay:BARGraph<n2>:B:LEGend:SHOW <state>
DISPlay:SWEep<n2>:A:LEGend:SHOW <state>
DISPlay:SWEep<n2>:B:LEGend:SHOW <state>
Parameters:
<state> ON | OFF

Manual operation: See "Show Title Show Leg A , Show Leg B" on page 530

DISPlay:FFT<n2>:A:LIMLower <state>
DISPlay:FFT<n2>:B:LIMLower <state>
DISPlay:WAVeform<n2>:A:LIMLower <state>
DISPlay:WAVeform<n2>:B:LIMLower <state>
DISPlay:BARGraph<n2>:A:LIMLower <state>
DISPlay:BARGraph<n2>:B:LIMLower <state>
DISPlay:SWEep<n2>:A:LIMLower <state>
DISPlay:SWEep<n2>:B:LIMLower <state>
Parameters:
<state> ON | OFF

Manual operation: See "Limit Lower" on page 515

DISPlay:FFT<n2>:A:LIMLower:SOURce <source>
DISPlay:FFT<n2>:B:LIMLower:SOURce <source>
DISPlay:WAVeform<n2>:A:LIMLower:SOURce <source>
DISPlay:WAVeform<n2>:B:LIMLower:SOURce <source>
DISPlay:BARGraph<n2>:A:LIMLower:SOURce <source>
DISPlay:BARGraph<n2>:B:LIMLower:SOURce <source>
DISPlay:SWEep<n2>:A:LIMLower:SOURce <source>
DISPlay:SWEep<n2>:B:LIMLower:SOURce <source>
Parameters:
<source> VALue | FILE | HOLD | IFILe

Manual operation: See "Source" on page 516

DISPlay:FFT<n2>:A:LIMLower:SOURce:FILE <file>
DISPlay:FFT<n2>:B:LIMLower:SOURce:FILE <file>
DISPlay:WAVeform<n2>:A:LIMLower:SOURce:FILE <file>
DISPlay:WAVeform<n2>:B:LIMLower:SOURce:FILE <file>
DISPlay:BARGraph<n2>:A:LIMLower:SOURce:FILE <file>
DISPlay:BARGraph<n2>:B:LIMLower:SOURce:FILE <file>
DISPlay:SWEep<n2>:A:LIMLower:SOURce:FILE <file>
DISPlay:SWEep<n2>:B:LIMLower:SOURce:FILE <file>
Parameters:
<file> string

Manual operation: See "Source Filename" on page 517

DISPlay:FFT<n2>:A:LIMLower:SOURce:VALue <value>
DISPlay:FFT<n2>:B:LIMLower:SOURce:VALue <value>
DISPlay:WAVeform<n2>:A:LIMLower:SOURce:VALue <value>
DISPlay:WAVeform<n2>:B:LIMLower:SOURce:VALue <value>
DISPlay:BARGraph<n2>:A:LIMLower:SOURce:VALue <value>
DISPlay:BARGraph<n2>:B:LIMLower:SOURce:VALue <value>
DISPlay:SWEep<n2>:A:LIMLower:SOURce:VALue <value>
DISPlay:SWEep<n2>:B:LIMLower:SOURce:VALue <value>
Parameters:
<value> float

Manual operation: See "Source Value" on page 517

DISPlay:FFT<n2>:A:LIMShift <state>
DISPlay:FFT<n2>:B:LIMShift <state>
DISPlay:WAVeform<n2>:A:LIMShift <state>
DISPlay:WAVeform<n2>:B:LIMShift <state>
DISPlay:BARGraph<n2>:A:LIMShift <state>
DISPlay:BARGraph<n2>:B:LIMShift <state>
DISPlay:SWEep<n2>:A:LIMShift <state>
DISPlay:SWEep<n2>:B:LIMShift <state>
Parameters:
<state> ON | OFF

Manual operation: See "Limit Shift" on page 517

DISPlay:FFT<n2>:A:LIMShift:PARallel <parallel>
DISPlay:FFT<n2>:B:LIMShift:PARallel <parallel>
DISPlay:WAVeform<n2>:A:LIMShift:PARallel <parallel>
DISPlay:WAVeform<n2>:B:LIMShift:PARallel <parallel>
DISPlay:BARGraph<n2>:A:LIMShift:PARallel <parallel>
DISPlay:BARGraph<n2>:B:LIMShift:PARallel <parallel>

DISPlay:SWEep<n2>:A:LIMShift:PARallel <parallel>
DISPlay:SWEep<n2>:B:LIMShift:PARallel <parallel>
Parameters:
<parallel> float

Manual operation: See "Parallel" on page 518

DISPlay:FFT<n2>:A:LIMShift:SYMMetrical <symmetrical>
DISPlay:FFT<n2>:B:LIMShift:SYMMetrical <symmetrical>
DISPlay:WAVeform<n2>:A:LIMShift:SYMMetrical <symmetrical>
DISPlay:WAVeform<n2>:B:LIMShift:SYMMetrical <symmetrical>
DISPlay:BARGraph<n2>:A:LIMShift:SYMMetrical <symmetrical>
DISPlay:BARGraph<n2>:B:LIMShift:SYMMetrical <symmetrical>
DISPlay:SWEep<n2>:A:LIMShift:SYMMetrical <symmetrical>
DISPlay:SWEep<n2>:B:LIMShift:SYMMetrical <symmetrical>
Parameters:
<symmetrical> float

Manual operation: See "Symmetrical" on page 518

DISPlay:FFT<n2>:A:LIMUpper <state>
DISPlay:FFT<n2>:B:LIMUpper <state>
DISPlay:WAVeform<n2>:A:LIMUpper <state>
DISPlay:WAVeform<n2>:B:LIMUpper <state>
DISPlay:BARGraph<n2>:A:LIMUpper <state>
DISPlay:BARGraph<n2>:B:LIMUpper <state>
DISPlay:SWEep<n2>:A:LIMUpper <state>
DISPlay:SWEep<n2>:B:LIMUpper <state>
Parameters:
<state> ON | OFF

Manual operation: See "Limit Upper" on page 512

DISPlay:FFT<n2>:A:LIMUpper:SOURce <source>
DISPlay:FFT<n2>:B:LIMUpper:SOURce <source>
DISPlay:WAVeform<n2>:A:LIMUpper:SOURce <source>
DISPlay:WAVeform<n2>:B:LIMUpper:SOURce <source>
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce <source>
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce <source>
DISPlay:SWEep<n2>:A:LIMUpper:SOURce <source>
DISPlay:SWEep<n2>:B:LIMUpper:SOURce <source>
Parameters:
<source> VALue | FILE | HOLD | IFILe

Manual operation: See "Source" on page 513

DISPlay:FFT<n2>:A:LIMUpper:SOURce:FILE <file>
DISPlay:FFT<n2>:B:LIMUpper:SOURce:FILE <file>

DISPlay:WAVeform<n2>:A:LIMUpper:SOURce:FILE <file>
DISPlay:WAVeform<n2>:B:LIMUpper:SOURce:FILE <file>
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:FILE <file>
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce:FILE <file>
DISPlay:SWEep<n2>:A:LIMUpper:SOURce:FILE <file>
DISPlay:SWEep<n2>:B:LIMUpper:SOURce:FILE <file>
Parameters:
<file> string

Manual operation: See "Source Filename" on page 515

DISPlay:FFT<n2>:A:LIMUpper:SOURce:VALue <value>
DISPlay:FFT<n2>:B:LIMUpper:SOURce:VALue <value>
DISPlay:WAVeform<n2>:A:LIMUpper:SOURce:VALue <value>
DISPlay:WAVeform<n2>:B:LIMUpper:SOURce:VALue <value>
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:VALue <value>
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce:VALue <value>
DISPlay:SWEep<n2>:A:LIMUpper:SOURce:VALue <value>
DISPlay:SWEep<n2>:B:LIMUpper:SOURce:VALue <value>
Parameters:
<value> float

Manual operation: See "Source Value" on page 514

DISPlay:FFT<n2>:A:NORMalize <normalize>
DISPlay:FFT<n2>:B:NORMalize <normalize>
DISPlay:BARGraph<n2>:A:NORMalize <normalize>
DISPlay:BARGraph<n2>:B:NORMalize <normalize>
DISPlay:SWEep<n2>:A:NORMalize <normalize>
DISPlay:SWEep<n2>:B:NORMalize <normalize>
Parameters:
<normalize> OFF | VALue | OCURsor | XCURsor

Manual operation: See "Normalize" on page 503

DISPlay:FFT<n2>:A:NORMalize:VALue <value>
DISPlay:FFT<n2>:B:NORMalize:VALue <value>
DISPlay:BARGraph<n2>:A:NORMalize:VALue <value>
DISPlay:BARGraph<n2>:B:NORMalize:VALue <value>
DISPlay:SWEep<n2>:A:NORMalize:VALue <value>
DISPlay:SWEep<n2>:B:NORMalize:VALue <value>
Parameters:
<value> float

Manual operation: See "Normalize Value" on page 504

DISPlay:FFT<n2>:A:REFerence <reference>
DISPlay:FFT<n2>:B:REFerence <reference>

DISPlay:WAVeform<n2>:A:REFerence <reference>
DISPlay:WAVeform<n2>:B:REFerence <reference>
DISPlay:BARGraph<n2>:A:REFerence <reference>
DISPlay:BARGraph<n2>:B:REFerence <reference>
DISPlay:SWEep<n2>:A:REFerence <reference>
DISPlay:SWEep<n2>:B:REFerence <reference>
Parameters:
<reference> VALue | FILE | HOLD | IFILe | MEASpanel | MAXimum | XCURsor | OCURsor | REF997 | REF1000 | CH1Meas | CH2Meas | GENTrack | NOISedensity | DBNOisedensity | MREFchannel

Manual operation: See "Reference" on page 499

DISPlay:FFT<n2>:A:REFerence:FILE <file>
DISPlay:FFT<n2>:B:REFerence:FILE <file>
DISPlay:BARGraph<n2>:A:REFerence:FILE <file>
DISPlay:BARGraph<n2>:B:REFerence:FILE <file>
DISPlay:SWEep<n2>:A:REFerence:FILE <file>
DISPlay:SWEep<n2>:B:REFerence:FILE <file>
Parameters:
<file> string

Manual operation: See "Reference File" on page 503

DISPlay:FFT<n2>:A:REFerence:VALue <value>
DISPlay:FFT<n2>:B:REFerence:VALue <value>
DISPlay:WAVeform<n2>:A:REFerence:VALue <value>
DISPlay:WAVeform<n2>:B:REFerence:VALue <value>
DISPlay:BARGraph<n2>:A:REFerence:VALue <value>
DISPlay:BARGraph<n2>:B:REFerence:VALue <value>
DISPlay:SWEep<n2>:A:REFerence:VALue <value>
DISPlay:SWEep<n2>:B:REFerence:VALue <value>
Parameters:
<value> float

Manual operation: See "Reference Value" on page 502

DISPlay:FFT<n2>:A:SPACing <spacing>
DISPlay:FFT<n2>:B:SPACing <spacing>
DISPlay:WAVeform<n2>:A:SPACing <spacing>
DISPlay:WAVeform<n2>:B:SPACing <spacing>
DISPlay:BARGraph<n2>:A:SPACing <spacing>
DISPlay:BARGraph<n2>:B:SPACing <spacing>
DISPlay:SWEep<n2>:A:SPACing <spacing>
DISPlay:SWEep<n2>:B:SPACing <spacing>
Parameters:
<spacing> LINear | LOGarithmic

Manual operation: See "Spacing" on page 509

DISPlay:FFT<n2>:A:TOP <top>
DISPlay:FFT<n2>:B:TOP <top>
DISPlay:WAVeform<n2>:A:TOP <top>
DISPlay:WAVeform<n2>:B:TOP <top>
DISPlay:BARGraph<n2>:A:TOP <top>
DISPlay:BARGraph<n2>:B:TOP <top>
DISPlay:SWEep<n2>:A:TOP <top>
DISPlay:SWEep<n2>:B:TOP <top>
Parameters:
<top> float

Manual operation: See "Top" on page 510

DISPlay:FFT<n2>:A:UNIT <unit>
DISPlay:FFT<n2>:B:UNIT <unit>
DISPlay:WAVeform<n2>:A:UNIT <unit>
DISPlay:WAVeform<n2>:B:UNIT <unit>
DISPlay:BARGraph<n2>:A:UNIT <unit>
DISPlay:BARGraph<n2>:B:UNIT <unit>
DISPlay:SWEep<n2>:A:UNIT <unit>
DISPlay:SWEep<n2>:B:UNIT <unit>

It is recommended to use the command recording in order to find the correct unit parameter, seechapter 6.7, "Command Recording", on page 632 .

Parameters:
<unit> string

Manual operation: See "Unit" on page 506

DISPlay:FFT<n2>:A:UNIT:AUTO <state>
DISPlay:FFT<n2>:B:UNIT:AUTO <state>
DISPlay:WAVeform<n2>:A:UNIT:AUTO <state>
DISPlay:WAVeform<n2>:B:UNIT:AUTO <state>
DISPlay:BARGraph<n2>:A:UNIT:AUTO <state>
DISPlay:BARGraph<n2>:B:UNIT:AUTO <state>
DISPlay:SWEep<n2>:A:UNIT:AUTO <state>
DISPlay:SWEep<n2>:B:UNIT:AUTO <state>
Parameters:
<state> ON | OFF

Manual operation: See "Unit Auto" on page 507

DISPlay:FFT<n2>:A:UNIT:TRACk <state>
DISPlay:FFT<n2>:B:UNIT:TRACk <state>
DISPlay:BARGraph<n2>:A:UNIT:TRACk <state>
DISPlay:BARGraph<n2>:B:UNIT:TRACk <state>

DISPlay:SWEep<n2>:A:UNIT:TRACk <state>
DISPlay:SWEep<n2>:B:UNIT:TRACk <state>
Parameters:
<state> ON | OFF

Manual operation: See "Unit Fnct Track" on page 504

DISPlay:FFT<n2>:A:UNIT:USER <user>
DISPlay:FFT<n2>:B:UNIT:USER <user>
DISPlay:WAVeform<n2>:A:UNIT:USER <user>
DISPlay:WAVeform<n2>:B:UNIT:USER <user>
DISPlay:BARGraph<n2>:A:UNIT:USER <user>
DISPlay:BARGraph<n2>:B:UNIT:USER <user>
DISPlay:SWEep<n2>:A:UNIT:USER <user>
DISPlay:SWEep<n2>:B:UNIT:USER <user>
Parameters:
<user> string

Manual operation: See "Unit User String" on page 508

DISPlay:FFT<n2>:A:UPDate <update>
DISPlay:FFT<n2>:B:UPDate <update>
DISPlay:WAVeform<n2>:A:UPDate <update>
DISPlay:WAVeform<n2>:B:UPDate <update>
DISPlay:BARGraph<n2>:A:UPDate <update>
DISPlay:BARGraph<n2>:B:UPDate <update>
DISPlay:SWEep<n2>:A:UPDate <update>
DISPlay:SWEep<n2>:B:UPDate <update>
Parameters:
<update> ALIVe | HOLD

Manual operation: See "Alive / Hold" on page 499

DISPlay:FFT<n2>:A:YSOurce <ysource>
DISPlay:FFT<n2>:B:YSOurce <ysource>
DISPlay:WAVeform<n2>:A:YSOurce <ysource>
DISPlay:WAVeform<n2>:B:YSOurce <ysource>
DISPlay:BARGraph<n2>:A:YSOurce <ysource>
DISPlay:BARGraph<n2>:B:YSOurce <ysource>

DISPlay:SWEep<n2>:A:YSOurce <ysource>
DISPlay:SWEep<n2>:B:YSOurce <ysource>
Parameters:
<ysource> available parameters depend on subsystem.

Parameters for Sweep subsystem:
OFF | FUNC1 | FUNC2 | FREQ1 | FREQ2 | PHASe | GROupdelay | LMRM1 | LMRM2 | LMDC1 | LMDC2 | LMPK1 | LMPK2 | INPP1 | INPP2 | FILEA | FILEB | FUNCtion | FREQuency | LMRMs | LMPK | INPPeak
Parameters for FFT subsystem:
OFF | FFTL1 | FFTL2 | FFTP1 | FFTP2 | FFTP21 | FILEA | FILEB | FFTLevel | FFTPhase | FFTRefchphase
Parameters for Waveform subsystem:
OFF | LEV1 | LEV2 | FILEA | FILEB | LEVel
Parameters for Bargraph subsystem:
OFF | FUNC1 | FUNC2 | FILEA | FILEB | FUNCtion

Manual operation: See "Y-Source" on page 489

DISPlay:FFT<n2>:A:YSOurce:FILE <file>
DISPlay:FFT<n2>:B:YSOurce:FILE <file>
DISPlay:WAVeform<n2>:A:YSOurce:FILE <file>
DISPlay:WAVeform<n2>:B:YSOurce:FILE <file>
DISPlay:BARGraph<n2>:A:YSOurce:FILE <file>
DISPlay:BARGraph<n2>:B:YSOurce:FILE <file>
DISPlay:SWEep<n2>:A:YSOurce:FILE <file>
DISPlay:SWEep<n2>:B:YSOurce:FILE <file>
Parameters:
<file> string

Manual operation: See "Trace File" on page 496

DISPlay:FFT<n2>:DLISt:FILTer <filter>
DISPlay:WAVeform<n2>:DLISt:FILTer <filter>
DISPlay:BARGraph<n2>:DLISt:FILTer <filter>
DISPlay:SWEep<n2>:DLISt:FILTer <filter>

Corresponds to the softkey operation in the list editor:

Selection

All | Lim Upper | Lim Lower | Lim upp&low | Harmonics | Peaks

When saving a trace by setting "Store Trace as" to "DataList Select" (MMEMory:Subsys<i>:STAS DSELect) or when trace data is read in with the following IEC/IEEE bus commands:

- `TRACe:Subsys<n2>:LDList:AX?`
- `TRACe:Subsys<n2>:LDList:AY?`
- `TRACe:Subsys<n2>:LDList:BX?`
- `TRACe:Subsys<n2>:LDList:BY?`

The IEC/IEEE bus command specifies which data is saved/read.

Parameters:

<filter> ALL | LIMUpper | LIMLower | LIMBoth | HARMonics | PEAKs

ALL
all

LIMUpper
Only those values that exceed the upper limit.

LIMLower
Only the values which are below the lower limit value.

LIMBoth
Only those values that exceed the upper limit and fall below the lower limit.

HARMonics
Only harmonics

PEAKs
Partial curve peaks

Example: `DISPlay:FFT:DLISt:FILTer HARMonics`

DISPlay:SWEep<n2>:HISTory <history>

Parameters:

<history> integer

Manual operation: See "History" on page 487

DISPlay:FFT<n2>:MINMax <state>
DISPlay:BARGraph<n2>:MINMax <state>
DISPlay:SWEep<n2>:MINMax <state>

Parameters:

<state> ON | OFF

Manual operation: See "Show Min Max " on page 488

DISPlay:FFT<n2>:MCHMode <state>
DISPlay:BARGraph<n2>:MCHMode <state>

Parameters:

<state> ON | OFF

Manual operation: See "Multi Ch Mode" on page 488

DISPlay:SWEep<n2>:SMODe <smode>

Parameters:

<smode> SINGlescan | MULTiscan

Manual operation: See "Scan" on page 486

DISPlay:FFT<n2>:TITLe:DESCription <description>
DISPlay:WAVeform<n2>:TITLe:DESCription <description>
DISPlay:BARGraph<n2>:TITLe:DESCription <description>
DISPlay:SWEep<n2>:TITLe:DESCription <description>
Parameters:
<description> string

Manual operation: See "Title Descript, Leg A Descript, Leg B Descript" on page 530

DISPlay:FFT<n2>:TITLe:SHOW <state>
DISPlay:WAVeform<n2>:TITLe:SHOW <state>
DISPlay:BARGraph<n2>:TITLe:SHOW <state>
DISPlay:SWEep<n2>:TITLe:SHOW <state>
Parameters:
<state> ON | OFF

Manual operation: See "Show Title Show Leg A , Show Leg B" on page 530

DISPlay:FFT<n2>:TRACk:LIMit <state>
DISPlay:WAVeform<n2>:TRACk:LIMit <state>
DISPlay:BARGraph<n2>:TRACk:LIMit <state>
DISPlay:SWEep<n2>:TRACk:LIMit <state>
Parameters:
<state> ON | OFF

Manual operation: See "Track" on page 497

DISPlay:FFT<n2>:TRACk:REFerence <state>
DISPlay:WAVeform<n2>:TRACk:REFerence <state>
DISPlay:BARGraph<n2>:TRACk:REFerence <state>
DISPlay:SWEep<n2>:TRACk:REFerence <state>
Parameters:
<state> ON | OFF

Manual operation: See "Track" on page 497

DISPlay:FFT<n2>:TRACk:SCALing <state>
DISPlay:WAVeform<n2>:TRACk:SCALing <state>
DISPlay:BARGraph<n2>:TRACk:SCALing <state>
DISPlay:SWEep<n2>:TRACk:SCALing <state>
Parameters:
<state> ON | OFF

Manual operation: See "Track" on page 497

DISPlay:SWEep<n2>:X:AXIS <axis>

Parameters:

<axis> TIME | VOLTage | FREQuency | PHASe | VDIGital | JPKamplitude | TIME | VOLTage | FREQuency | PHASe | VDIGital

Manual operation: See "X-axis " on page 522

DISPlay:FFT<n2>:X:LABel:AUTO <state>
DISPlay:WAVeform<n2>:X:LABel:AUTO <state>
DISPlay:SWEep<n2>:X:LABel:AUTO <state>

Parameters:

<state> ON | OFF

Manual operation: See "Label Auto" on page 525

DISPlay:FFT<n2>:X:LABel:USER <user>
DISPlay:WAVeform<n2>:X:LABel:USER <user>
DISPlay:SWEep<n2>:X:LABel:USER <user>

Parameters:

<user> string

Manual operation: See "Label Auto" on page 525

DISPlay:FFT<n2>:X:LEFT <left>
DISPlay:WAVeform<n2>:X:LEFT <left>
DISPlay:SWEep<n2>:X:LEFT <left>

Parameters:

<left> float

Manual operation: See "Left" on page 527

DISPlay:FFT<n2>:X:REFerence:VALue <value>
DISPlay:WAVeform<n2>:X:REFerence:VALue <value>
DISPlay:SWEep<n2>:X:REFerence:VALue <value>

Parameters:

<value> float

Manual operation: See "Ref Value " on page 526

DISPlay:FFT<n2>:X:RIGHt <right>
DISPlay:WAVeform<n2>:X:RIGHt <right>
DISPlay:SWEep<n2>:X:RIGHt <right>

Parameters:

<right> float

Manual operation: See "Right" on page 528

DISPlay:FFT<n2>:X:SCALing <scaling>
DISPlay:WAVeform<n2>:X:SCALing <scaling>
DISPlay:SWEep<n2>:X:SCALing <scaling>
Parameters:
<scaling> AUTO | MANual

Manual operation: See "Scaling" on page 527

DISPlay:SWEep<n2>:X:SOURce <source>

Parameters:
<source> SWEep | HOLD | MANual | LRMS | LDC | LPEak | FREQuency

Manual operation: See "X-Source" on page 520

DISPlay:FFT<n2>:X:SPACing <spacing>
DISPlay:WAVeform<n2>:X:SPACing <spacing>
DISPlay:SWEep<n2>:X:SPACing <spacing>
Parameters:
<spacing> LINear | LOGarithmic

Manual operation: See "Spacing" on page 527

DISPlay:FFT<n2>:X:UNIT <unit>
DISPlay:WAVeform<n2>:X:UNIT <unit>
DISPlay:SWEep<n2>:X:UNIT <unit>

It is recommended to use the command recording in order to find the correct unit parameter, seechapter 6.7, "Command Recording", on page 632 .

Parameters:
<unit> string

Manual operation: See "Unit" on page 524

DISPlay:FFT<n2>:X:UNIT:AUTO <state>
DISPlay:WAVeform<n2>:X:UNIT:AUTO <state>
DISPlay:SWEep<n2>:X:UNIT:AUTO <state>
Parameters:
<state> ON | OFF

Manual operation: See "Unit Auto" on page 526

DISPlay:FFT<n2>:X:UNIT:USER <user>
DISPlay:WAVeform<n2>:X:UNIT:USER <user>
DISPlay:SWEep<n2>:X:UNIT:USER <user>
Parameters:
<user> string

Manual operation: See "Unit User String" on page 526

MMEMory:FFT<n2>:EQUalization:INVert <state>
MMEMory:SWEep<n2>:EQUalization:INVert <state>
Parameters:
<state> ON | OFF

Manual operation: See "Invert" on page 533

MMEMory:FFT<n2>:EQUalization:MODify <state>
MMEMory:SWEep<n2>:EQUalization:MODify <state>
Parameters:
<state> ON | OFF

Manual operation: See "Modify Equ." on page 533

MMEMory:FFT<n2>:EQUalization:NORMfrequency <normfrequency>
MMEMory:SWEep<n2>:EQUalization:NORMfrequency <normfrequency>
Parameters:
<normfrequency> float

Manual operation: See "Norm Freq" on page 532

MMEMory:FFT<n2>:LIMit:OFFSet <state>
MMEMory:BARGraph<n2>:LIMit:OFFSet <state>
MMEMory:SWEep<n2>:LIMit:OFFSet <state>
Parameters:
<state> ON | OFF

Manual operation: See "Offset " on page 534

MMEMory:FFT<n2>:LIMit:OFFSet:VALue <value>
MMEMory:BARGraph<n2>:LIMit:OFFSet:VALue <value>
MMEMory:SWEep<n2>:LIMit:OFFSet:VALue <value>
Parameters:
<value> float

Manual operation: See "Offset Value" on page 534

MMEMory:FFT<n2>:STAS <stas>
MMEMory:WAVeform<n2>:STAS <stas>
MMEMory:BARGraph<n2>:STAS <stas>
MMEMory:SWEep<n2>:STAS <stas>
Parameters:
<stas> TRCList | EQUList | SWPList | LLISt | DSELect

Manual operation: See "Store Trace as" on page 531

MMEMory:FFT<n2>:STORe <store>
MMEMory:WAVeform<n2>:STORe <store>
MMEMory:BARGraph<n2>:STORe <store>
MMEMory:SWEep<n2>:STORe <store>
Parameters:
<store> 'filename'

Manual operation: See "Store Trace to" on page 535

MMEMory:FFT<n2>:TRACe <trace>
MMEMory:BARGraph<n2>:TRACe <trace>
MMEMory:SWEep<n2>:TRACe <trace>
Parameters:
<trace> A | B

Manual operation: See "Trace " on page 532

SENSe<n1>:CONFig:COPYother <state>

Suffix:
<n1> 1 | 2 | 6

Parameters:
<state> ONCE | EXEC

Manual operation: See "Copy to other Windows" on page 486
See "Copy to Ch2" on page 561

7.24 Combi Display

7.24.1 Measurement Result Configuration

- SENSe3:FREQuency:LEFT on page 769
- SENSe3:FREQuency:LIMLower on page 769
- SENSe3:FREQuency:LIMLower:VALue on page 770
- SENSe3:FREQuency:LIMUpper on page 770
- SENSe3:FREQuency:LIMUpper:VALue on page 770
- SENSe3:FREQuency:REFerence on page 770
- SENSe3:FREQuency:REFerence:MODE on page 770
- SENSe3:FREQuency:RIGHt on page 771
- SENSe3:FREQuency:UNAuto on page 771

- SENSe3:FREQuency:UNIT on page 771
- SENSe3:FREQuency:USERunit on page 771
- SENSe3:GROupdelay:REFerence on page 771
- SENSe<n1>:LEFT<n2> on page 772
- SENSe<n1>:LIMLower<n2> on page 772
- SENSe<n1>:LIMLower<n2>:VALue on page 772
- SENSe<n1>:LIMUpper<n2> on page 772
- SENSe<n1>:LIMUpper<n2>:VALue on page 772
- SENSe3:PHASe:LEFT on page 772
- SENSe3:PHASe:LIMLower on page 773
- SENSe3:PHASe:LIMLower:VALue on page 773
- SENSe3:PHASe:LIMUpper on page 773
- SENSe3:PHASe:LIMUpper:VALue on page 773
- SENSe3:PHASe:REFerence on page 773
- SENSe3:PHASe:REFerence:MODE on page 774
- SENSe3:PHASe:RIGHt on page 774
- SENSe3:PHASe:UNAuto on page 774
- SENSe3:PHASe:UNIT on page 774
- SENSe3:PHASe:UNAuto on page 774
- SENSe<n1>:REFerence<n2> on page 775
- SENSe<n1>:REFerence<n2>:MODE<n3> on page 775
- SENSe<n1>:RIGHt<n2> on page 775
- SENSe<n1>:UNAuto<n2> on page 775
- SENSe<n1>:UNIT<n2> on page 776
- SENSe<n1>:USERunit<n2> on page 776

SENSe3:FREQuency:LEFT <left>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<left> float

Manual operation: See "Left" on page 566

SENSe3:FREQuency:LIMLower <limlower>

Suffix:
3 3 = frequency, phase, and group delay-measurement

Parameters:
<limlower> ON | OFF

Manual operation: See "Limit Lower" on page 568

SENSe3:FREQuency:LIMLower:VALue <value>

Suffix:
3 3 = frequency, phase, and group delay-measurement

Parameters:
<value> float

Manual operation: See "Limit Lower" on page 568

SENSe3:FREQuency:LIMUpper <limupper>

Suffix:
3 3 = frequency, phase, and group delay-measurement

Parameters:
<limupper> ON | OFF

Manual operation: See "Limit Upper" on page 570

SENSe3:FREQuency:LIMUpper:VALue <value>

Suffix:
3 3 = frequency, phase and group delay measurement

Parameters:
<value> float

Manual operation: See "Limit Upper" on page 570

SENSe3:FREQuency:REFerence <reference>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<reference> float

Manual operation: See "Reference" on page 564

SENSe3:FREQuency:REFerence:MODE <mode>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<mode> CH1Meas | CH2Meas | VALue | STORe | SOURce | GENTrack | DIGoutampl | MREFchannel | CH1Store | CH2Store | CH3Store | CH4Store | CH5Store | CH6Store | CH7Store | CH8Store

Manual operation: See "Reference" on page 564

SENSe3:FREQuency:RIGHt <right>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<right> float

Manual operation: See "Right" on page 566

SENSe3:FREQuency:UNAuto <unauto>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<state> ON | OFF

Manual operation: See "Unit Auto" on page 562

SENSe3:FREQuency:UNIT <unit>

It is recommended to use the command recording in order to find the correct unit parameter, see chapter 6.7, "Command Recording", on page 632 .

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<unit> selection

Manual operation: See "Unit" on page 561

SENSe3:FREQuency:USERunit <userunit>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<userunit> string

Manual operation: See "Unit Auto" on page 562

SENSe3:GROupdelay:REFerence <reference>

Parameters:
<reference> float

Manual operation: See "Reference" on page 564

SENSe<n1>:LEFT<n2> <left>

Suffix:
<n1> 1 | 2 | 6

<n2> 1 | 2

Parameters:
<left> float

Manual operation: See "Left" on page 566

SENSe<n1>:LIMLower<n2> <limlower>

Parameters:
<limlower> ON | OFF

Manual operation: See "Limit Lower" on page 568

SENSe<n1>:LIMLower<n2>:VALue <value>

Parameters:
<value> float

Manual operation: See "Limit Lower" on page 568

SENSe<n1>:LIMUpper<n2> <limupper>

Parameters:
<limupper> ON | OFF

Manual operation: See "Limit Upper" on page 570

SENSe<n1>:LIMUpper<n2>:VALue <value>

Parameters:
<value> float

Manual operation: See "Limit Upper" on page 570

SENSe3:PHASe:LEFT <left>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<left> float

Manual operation: See "Left" on page 566

SENSe3:PHASe:LIMLower <limlower>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<limlower> ON | OFF

Manual operation: See "Limit Lower" on page 568

SENSe3:PHASe:LIMLower:VALue <value>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<value> float

Manual operation: See "Limit Lower" on page 568

SENSe3:PHASe:LIMUpper <limupper>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<limupper> ON | OFF

Manual operation: See "Limit Upper" on page 570

SENSe3:PHASe:LIMUpper:VALue <value>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<value> float

Manual operation: See "Limit Upper" on page 570

SENSe3:PHASe:REFerence <reference>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<reference> float

Manual operation: See "Reference" on page 564

SENSe3:PHASe:REFerence:MODE <mode>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<mode> STORe | VALue | GENTrack

Manual operation: See "Reference" on page 564

SENSe3:PHASe:RIGHt <right>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<right> float

Manual operation: See "Right" on page 566

SENSe3:PHASe:UNAuto <unauto>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<unauto> ON | OFF

Manual operation: See "Unit Auto" on page 562

SENSe3:PHASe:UNIT <unit>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<unit> selection

Manual operation: See "Unit" on page 561

SENSe3:PHASe:USERunit <userunit>

Suffix:
3 3 = frequency, phase, or group delay measurement

Parameters:
<userunit> string

Manual operation: See "Unit Auto" on page 562

SENSe<n1>:REFerence<n2> <reference>

Suffix:
<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
6 = level monitor measurement

Parameters:
<reference> float

Manual operation: See "Reference" on page 564

SENSe<n1>:REFerence<n2>:MODE<n3> <mode>

Suffix:
<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
6 = level monitor measurement

Parameters:
<mode> CH1Meas | CH2Meas | VALue | STORe | SOURce | GENTrack | MREFchannel | CH1Store | CH2Store | CH3Store | CH4Store | CH5Store | CH6Store | CH7Store | CH8Store

Manual operation: See "Reference" on page 564

SENSe<n1>:RIGHt<n2> <right>

Suffix:
<n1> 1 | 2 | 6

<n2> 1 | 2

Parameters:
<right> float

Manual operation: See "Right" on page 566

SENSe<n1>:UNAuto<n2> <unauto>

Suffix:
<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
6 = level monitor measurement

Parameters:
<unauto> ON | OFF

Manual operation: See "Unit Auto" on page 562

SENSe<n1>:UNIT<n2> <unit>

This command cannot be recorded, see chapter 6.7, "Command Recording", on page 632 .

Suffix:
<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
6 = level monitor measurement

Parameters:
<unit> selection

Manual operation: See "Unit" on page 561

SENSe<n1>:USERunit<n2> <userunit>

Suffix:
<n1> specifies the type of measurement.
1 = function measurement (level / signal to noise / distortion, ...)
2 = input monitor measurement
6 = level monitor measurement

<n2> 1 | 2

Parameters:
<userunit> string

Manual operation: See "Unit Auto" on page 562

7.25 Softkey Commands of the Graphical Display

This section includes all commands of the softkey menu of the graphical and list displays. These commands cannot be recorded.

Only a few commands are allowed in all subsystems. Commands that are not allowed in a subsystem are not listed here.

In the `BARGraph` subsystem, for example, there are no markers.

The `DISPlay:BARGraph<n2>:A|B:MARKer:HARMonics ON | OFF` command is thus not allowed, and is not listed in the following command description.

The value range for suffix <n2> depends on the subsystem:

For the Subsystem Sweep:	<n2> = 1 … 4
For the Subsystem FFT:	<n2> = 1 | 2
For the Subsystem BARGraph:	<n2> = 1 | 2
For the Subsystems WAVeform:	<n2> = 1

- DISPlay:BARGraph<n2>:DLISt:FILTer on page 762
- DISPlay:BARGraph<n2>:OCURsor:MODE on page 781
- DISPlay:BARGraph<n2>:OCURsor:POSMode on page 782
- DISPlay:BARGraph<n2>:OCURsor:SETTo:MAX on page 783
- DISPlay:BARGraph<n2>:OCURsor:SETTo:MIN on page 784
- DISPlay:BARGraph<n2>:OCURsor:SETTo:XPOS on page 785
- DISPlay:BARGraph<n2>:OCURsor:SETTo:YPOS on page 785
- DISPlay:BARGraph<n2>:OCURsor:STATe on page 786
- DISPlay:BARGraph<n2>:OCURsor:Y? on page 786
- DISPlay:BARGraph<n2>:XCURsor:MODE on page 781
- DISPlay:BARGraph<n2>:XCURsor:POSMode on page 782
- DISPlay:BARGraph<n2>:XCURsor:SETTo:MAX on page 783
- DISPlay:BARGraph<n2>:XCURsor:SETTo:MIN on page 784
- DISPlay:BARGraph<n2>:XCURsor:SETTo:XPOS on page 785
- DISPlay:BARGraph<n2>:XCURsor:SETTo:YPOS on page 785
- DISPlay:BARGraph<n2>:XCURsor:STATe on page 786
- DISPlay:BARGraph<n2>:XCURsor:Y? on page 786
- DISPlay:FFT<n2>:A:MARKer:HARMonics on page 779
- DISPlay:FFT<n2>:A:MARKer:MODE on page 780
- DISPlay:FFT<n2>:A:MARKer:SETTo:OCURsor on page 780
- DISPlay:FFT<n2>:A:MARKer:SETTo:XCURsor on page 780
- DISPlay:FFT<n2>:A:MARKer:SETTo:XPOS on page 781
- DISPlay:FFT<n2>:B:MARKer:HARMonics on page 779
- DISPlay:FFT<n2>:B:MARKer:MODE on page 780
- DISPlay:FFT<n2>:B:MARKer:SETTo:OCURsor on page 780
- DISPlay:FFT<n2>:B:MARKer:SETTo:XCURsor on page 780
- DISPlay:FFT<n2>:B:MARKer:SETTo:XPOS on page 781
- DISPlay:FFT<n2>:DLISt:FILTer on page 762
- DISPlay:FFT<n2>:OCURsor:MODE on page 781
- DISPlay:FFT<n2>:OCURsor:POSMode on page 782
- DISPlay:FFT<n2>:OCURsor:SETTo:MAX on page 783
- DISPlay:FFT<n2>:OCURsor:SETTo:MIN on page 783
- DISPlay:FFT<n2>:OCURsor:SETTo:MRKA on page 784
- DISPlay:FFT<n2>:OCURsor:SETTo:MRKB on page 785
- DISPlay:FFT<n2>:OCURsor:SETTo:XPOS on page 785
- DISPlay:FFT<n2>:OCURsor:SETTo:YPOS on page 785
- DISPlay:FFT<n2>:OCURsor:STATe on page 786

- DISPlay:FFT<n2>:OCURsor:Y? on page 786
- DISPlay:FFT<n2>:XCURsor:MODE on page 781
- DISPlay:FFT<n2>:XCURsor:POSMode on page 782
- DISPlay:FFT<n2>:XCURsor:SETTo:MAX on page 783
- DISPlay:FFT<n2>:XCURsor:SETTo:MIN on page 783
- DISPlay:FFT<n2>:XCURsor:SETTo:MRKA on page 784
- DISPlay:FFT<n2>:XCURsor:SETTo:MRKB on page 785
- DISPlay:FFT<n2>:XCURsor:SETTo:XPOS on page 785
- DISPlay:FFT<n2>:XCURsor:SETTo:YPOS on page 785
- DISPlay:FFT<n2>:XCURsor:STATe on page 786
- DISPlay:FFT<n2>:XCURsor:Y? on page 786
- DISPlay:SWEep<n2>:A:MARKer:MODE on page 780
- DISPlay:SWEep<n2>:A:MARKer:SETTo:OCURsor on page 780
- DISPlay:SWEep<n2>:A:MARKer:SETTo:XCURsor on page 780
- DISPlay:SWEep<n2>:A:MARKer:SETTo:XPOS on page 781
- DISPlay:SWEep<n2>:B:MARKer:MODE on page 780
- DISPlay:SWEep<n2>:B:MARKer:SETTo:OCURsor on page 781
- DISPlay:SWEep<n2>:B:MARKer:SETTo:XCURsor on page 781
- DISPlay:SWEep<n2>:B:MARKer:SETTo:XPOS on page 781
- DISPlay:SWEep<n2>:DLISt:FILTer on page 762
- DISPlay:SWEep<n2>:OCURsor:MODE on page 782
- DISPlay:SWEep<n2>:OCURsor:POSMode on page 782
- DISPlay:SWEep<n2>:OCURsor:SETTo:MAX on page 783
- DISPlay:SWEep<n2>:OCURsor:SETTo:MIN on page 784
- DISPlay:SWEep<n2>:OCURsor:SETTo:MRKA on page 784
- DISPlay:SWEep<n2>:OCURsor:SETTo:MRKB on page 785
- DISPlay:SWEep<n2>:OCURsor:SETTo:XPOS on page 785
- DISPlay:SWEep<n2>:OCURsor:SETTo:YPOS on page 785
- DISPlay:SWEep<n2>:OCURsor:STATe on page 786
- DISPlay:SWEep<n2>:OCURsor:Y? on page 787
- DISPlay:SWEep<n2>:XCURsor:MODE on page 782
- DISPlay:SWEep<n2>:XCURsor:POSMode on page 782
- DISPlay:SWEep<n2>:XCURsor:SETTo:MAX on page 783
- DISPlay:SWEep<n2>:XCURsor:SETTo:MIN on page 784
- DISPlay:SWEep<n2>:XCURsor:SETTo:MRKA on page 784
- DISPlay:SWEep<n2>:XCURsor:SETTo:MRKB on page 785
- DISPlay:SWEep<n2>:XCURsor:SETTo:XPOS on page 785

- DISPlay:SWEep<n2>:XCURsor:SETTo:YPOS on page 785
- DISPlay:SWEep<n2>:XCURsor:STATe on page 786
- DISPlay:SWEep<n2>:XCURsor:Y? on page 787
- DISPlay:WAVeform<n2>:A:MARKer:MODE on page 780
- DISPlay:WAVeform<n2>:A:MARKer:SETTo:OCURsor on page 780
- DISPlay:WAVeform<n2>:A:MARKer:SETTo:XCURsor on page 780
- DISPlay:WAVeform<n2>:A:MARKer:SETTo:XPOS on page 781
- DISPlay:WAVeform<n2>:B:MARKer:MODE on page 780
- DISPlay:WAVeform<n2>:B:MARKer:SETTo:OCURsor on page 780
- DISPlay:WAVeform<n2>:B:MARKer:SETTo:XCURsor on page 780
- DISPlay:WAVeform<n2>:B:MARKer:SETTo:XPOS on page 781
- DISPlay:WAVeform<n2>:DLISt:FILTer on page 762
- DISPlay:WAVeform<n2>:OCURsor:MODE on page 781
- DISPlay:WAVeform<n2>:OCURsor:POSMode on page 782
- DISPlay:WAVeform<n2>:OCURsor:SETTo:MAX on page 783
- DISPlay:WAVeform<n2>:OCURsor:SETTo:MIN on page 783
- DISPlay:WAVeform<n2>:OCURsor:SETTo:MRKA on page 784
- DISPlay:WAVeform<n2>:OCURsor:SETTo:MRKB on page 785
- DISPlay:WAVeform<n2>:OCURsor:SETTo:XPOS on page 785
- DISPlay:WAVeform<n2>:OCURsor:SETTo:YPOS on page 785
- DISPlay:WAVeform<n2>:OCURsor:STATe on page 786
- DISPlay:WAVeform<n2>:OCURsor:Y? on page 786
- DISPlay:WAVeform<n2>:XCURsor:MODE on page 781
- DISPlay:WAVeform<n2>:XCURsor:POSMode on page 782
- DISPlay:WAVeform<n2>:XCURsor:SETTo:MAX on page 783
- DISPlay:WAVeform<n2>:XCURsor:SETTo:MIN on page 784
- DISPlay:WAVeform<n2>:XCURsor:SETTo:MRKA on page 784
- DISPlay:WAVeform<n2>:XCURsor:SETTo:MRKB on page 785
- DISPlay:WAVeform<n2>:XCURsor:SETTo:XPOS on page 785
- DISPlay:WAVeform<n2>:XCURsor:SETTo:YPOS on page 785
- DISPlay:WAVeform<n2>:XCURsor:STATe on page 786
- DISPlay:WAVeform<n2>:XCURsor:Y? on page 786

DISPlay:FFT<n2>:A:MARKer:HARMonics <state>
DISPlay:FFT<n2>:B:MARKer:HARMonics <state>

Corresponds to softkey operation:

Marker,

Trace A | Trace B,

Harm

Parameters:

<state> ON | OFF

ON
The harmonics are calculated and displayed, starting from the X position of the marker.

OFF
Display of the harmonics is switched off.

Example: `DISPlay:FFT2:A:MARKer:HARMonics ON`

DISPlay:FFT<n2>:A:MARKer:MODE <mode>
DISPlay:FFT<n2>:B:MARKer:MODE <mode>
DISPlay:WAVeform<n2>:A:MARKer:MODE <mode>
DISPlay:WAVeform<n2>:B:MARKer:MODE <mode>
DISPlay:SWEep<n2>:A:MARKer:MODE <mode>
DISPlay:SWEep<n2>:B:MARKer:MODE <mode>

Corresponds to softkey operation:

Marker,

Trace A | Trace B,

Off | Track to Max

Parameters:

<mode> OFF | FIXed | TRKMax

OFF
Marker off

FIXed
Fix marker on the current X position

TRKMax
Set marker to maximum of trace A. Marker changes with maximum.

Example: `DISPlay:FFT:B:MARKer:MODE TRKMax`

DISPlay:FFT<n2>:A:MARKer:SETTo:OCURsor <state>
DISPlay:FFT<n2>:A:MARKer:SETTo:XCURsor <state>
DISPlay:FFT<n2>:B:MARKer:SETTo:OCURsor <state>
DISPlay:FFT<n2>:B:MARKer:SETTo:XCURsor <state>
DISPlay:WAVeform<n2>:A:MARKer:SETTo:OCURsor <state>
DISPlay:WAVeform<n2>:A:MARKer:SETTo:XCURsor <state>
DISPlay:WAVeform<n2>:B:MARKer:SETTo:OCURsor <state>
DISPlay:WAVeform<n2>:B:MARKer:SETTo:XCURsor <state>
DISPlay:SWEep<n2>:A:MARKer:SETTo:OCURsor <state>
DISPlay:SWEep<n2>:A:MARKer:SETTo:XCURsor <state>

DISPlay:SWEep<n2>:B:MARKer:SETTo:OCURsor <state>
DISPlay:SWEep<n2>:B:MARKer:SETTo:XCURsor <state>

Corresponds to softkey operation:

Marker,

Trace A | Trace B,

O Cursor | X Cursor

Parameters:

<state> ONCE | EXEC

ONCE or EXEC can also be omitted.

ONCE
Set marker to position of O cursor | X cursor

EXEC
Alias to ONCE.

Example:
```
DISPlay:SWEep:A:MARKer:SETTo:XCURsor
DISPlay:SWEep:A:MARKer:SETTo:XCURsor ONCE
DISPlay:SWEep:A:MARKer:SETTo:XCURsor EXEC
```
the three commands are equivalent.

DISPlay:FFT<n2>:A:MARKer:SETTo:XPOS <xpos>
DISPlay:FFT<n2>:B:MARKer:SETTo:XPOS <xpos>
DISPlay:WAVeform<n2>:A:MARKer:SETTo:XPOS <xpos>
DISPlay:WAVeform<n2>:B:MARKer:SETTo:XPOS <xpos>
DISPlay:SWEep<n2>:A:MARKer:SETTo:XPOS <xpos>
DISPlay:SWEep<n2>:B:MARKer:SETTo:XPOS <xpos>

Corresponds to the softkey operation:

Marker,

Trace A | Trace B,

Set to Value

Parameters:

<xpos> float

Set marker to a position on the X-axis. The unit for entering the value depends on the unit of the X-axis.

Example:
```
DISPlay:FFT2:B:MARKer:SETTo:XPOS 12.345 Hz
```

DISPlay:FFT<n2>:OCURsor:MODE <mode>
DISPlay:FFT<n2>:XCURsor:MODE <mode>
DISPlay:WAVeform<n2>:OCURsor:MODE <mode>
DISPlay:WAVeform<n2>:XCURsor:MODE <mode>
DISPlay:BARGraph<n2>:OCURsor:MODE <mode>
DISPlay:BARGraph<n2>:XCURsor:MODE <mode>

DISPlay:SWEep<n2>:OCURsor:MODE <mode>
DISPlay:SWEep<n2>:XCURsor:MODE <mode>

Corresponds to softkey operation:

Cursor

O Cursor

O Vert A | O Vert B | O Vert A-B, O Hor A | O Hor B

Cursor

X cursor,

X Vert A | X Vert B | X Vert A-B, X Hor A | X Hor B

Parameters:

<mode> VA | VB | VAB | HA | HB

VA
O cursor becomes vertical cursor on trace A

VB
Same on trace B

VAB
Same on trace A and trace B and shows difference between Y values.

HA
O cursor becomes horizontal cursor on trace A

HB
Same on trace B

Example:

```
DISPlay:BARGraph:XCURsor:MODE VA
```

DISPlay:FFT<n2>:OCURsor:POSMode <posmode>
DISPlay:FFT<n2>:XCURsor:POSMode <posmode>
DISPlay:WAVeform<n2>:OCURsor:POSMode <posmode>
DISPlay:WAVeform<n2>:XCURsor:POSMode <posmode>
DISPlay:BARGraph<n2>:OCURsor:POSMode <posmode>
DISPlay:BARGraph<n2>:XCURsor:POSMode <posmode>
DISPlay:SWEep<n2>:OCURsor:POSMode <posmode>
DISPlay:SWEep<n2>:XCURsor:POSMode <posmode>

Corresponds to softkey operation:

Cursor

O cursor | X cursor

Movement

Next Pixel | Next Bin | Next Sample | Next Value | Next Step | Next Peak | Next Harmonic

Parameters:

<posmode> PIXel | POINt | PEAK | HARMonic

PIXel
Pixel-by-pixel cursor movement

POINt
Same between reference points. An easy-to-remember term is offered for each subsystem in the softkey menu, such as "Next Bin" for FFT, "Next Sample" for waveform, "Next Value" for bar-graph and "Next Step" for sweep; the generic term `POINt` is used for IEC/IEEE bus control to simplify matters.

PEAK
Same between partial curve peaks

HARMonic
Same in the FFT display between harmonics

Example:
```
DISPlay:WAVeform:OCURsor:POSMode POINt
```

DISPlay:FFT<n2>:OCURsor:SETTo:MAX <state>
DISPlay:FFT<n2>:XCURsor:SETTo:MAX <state>
DISPlay:WAVeform<n2>:OCURsor:SETTo:MAX <state>
DISPlay:WAVeform<n2>:XCURsor:SETTo:MAX <state>
DISPlay:BARGraph<n2>:OCURsor:SETTo:MAX <state>
DISPlay:BARGraph<n2>:XCURsor:SETTo:MAX <state>
DISPlay:SWEep<n2>:OCURsor:SETTo:MAX <state>
DISPlay:SWEep<n2>:XCURsor:SETTo:MAX <state>

Corresponds to softkey operation:

Cursor

Set O-Cursor | Set X-Cursor,

Max

Parameters:

<state> ONCE | EXEC

ONCE or EXEC can also be omitted.

ONCE
Sets O cursor | X Cursor to the curve peak.

EXEC
Alias to ONCE.

Example:
```
DISPlay:SWEep4:OCURsor:SETTo:MAX
DISPlay:SWEep4:OCURsor:SETTo:MAX ONCE
DISPlay:SWEep4:OCURsor:SETTo:MAX EXEC
```
the three commands are equivalent.

DISPlay:FFT<n2>:OCURsor:SETTo:MIN <state>
DISPlay:FFT<n2>:XCURsor:SETTo:MIN <state>
DISPlay:WAVeform<n2>:OCURsor:SETTo:MIN <state>

DISPlay:WAVeform<n2>:XCURsor:SETTo:MIN <state>
DISPlay:BARGraph<n2>:OCURsor:SETTo:MIN <state>
DISPlay:BARGraph<n2>:XCURsor:SETTo:MIN <state>
DISPlay:SWEep<n2>:OCURsor:SETTo:MIN <state>
DISPlay:SWEep<n2>:XCURsor:SETTo:MIN <state>

Corresponds to softkey operation:

Cursor

Set O-Cursor | Set X-Cursor,

Min

Parameters:

<state> ONCE | EXEC

ONCE or EXEC can also be omitted.

ONCE
Sets O cursor | X Cursor to trace minimum.

EXEC
Alias to ONCE.

Example:
```
DISPlay:SWEep4:XCURsor:SETTo:MIN
DISPlay:SWEep4:XCURsor:SETTo:MIN ONCE
DISPlay:SWEep4:XCURsor:SETTo:MIN EXEC
```
the three commands are equivalent.

DISPlay:FFT<n2>:OCURsor:SETTo:MRKA <state>
DISPlay:FFT<n2>:XCURsor:SETTo:MRKA <state>
DISPlay:WAVeform<n2>:OCURsor:SETTo:MRKA <state>
DISPlay:WAVeform<n2>:XCURsor:SETTo:MRKA <state>
DISPlay:SWEep<n2>:OCURsor:SETTo:MRKA <state>
DISPlay:SWEep<n2>:XCURsor:SETTo:MRKA <state>

Corresponds to softkey operation:

Cursor

Set O cursor | Set X cursor,

Marker A

Parameters:

<state> ONCE | EXEC

ONCE or EXEC can also be omitted.

ONCE
Sets O cursor | X cursor to the position of marker A

EXEC
Alias to ONCE.

Example:
```
DISPlay:SWEep4:XCURsor:SETTo:MRKA
DISPlay:SWEep4:XCURsor:SETTo:MRKA ONCE
DISPlay:SWEep4:XCURsor:SETTo:MRKA EXEC
```
the three commands are equivalent.

DISPlay:FFT<n2>:OCURsor:SETTo:MRKB <state>
DISPlay:FFT<n2>:XCURsor:SETTo:MRKB <state>
DISPlay:WAVeform<n2>:OCURsor:SETTo:MRKB <state>
DISPlay:WAVeform<n2>:XCURsor:SETTo:MRKB <state>
DISPlay:SWEep<n2>:OCURsor:SETTo:MRKB <state>
DISPlay:SWEep<n2>:XCURsor:SETTo:MRKB <state>

Corresponds to softkey operation:

Cursor

Set O cursor | Set X cursor,

Marker B

Parameters:

<state> ONCE | EXEC | OFF

DISPlay:FFT<n2>:OCURsor:SETTo:XPOS <xpos>
DISPlay:FFT<n2>:XCURsor:SETTo:XPOS <xpos>
DISPlay:WAVeform<n2>:OCURsor:SETTo:XPOS <xpos>
DISPlay:WAVeform<n2>:XCURsor:SETTo:XPOS <xpos>
DISPlay:BARGraph<n2>:OCURsor:SETTo:XPOS <xpos>
DISPlay:BARGraph<n2>:XCURsor:SETTo:XPOS <xpos>
DISPlay:SWEep<n2>:OCURsor:SETTo:XPOS <xpos>
DISPlay:SWEep<n2>:XCURsor:SETTo:XPOS <xpos>

Corresponds to softkey operation:

Cursor

Set O cursor | Set X cursor,

Value

Parameters:

<xpos> float

Sets O cursor | X cursor to the defined value if a vertical cursor is involved.
The unit in which the value is entered depends on the unit of the X-axis.

Example:

```
DISPlay:WAVeform:OCURsor:SETTo:XPOS 12.345 Hz
```

DISPlay:FFT<n2>:OCURsor:SETTo:YPOS <ypos>
DISPlay:FFT<n2>:XCURsor:SETTo:YPOS <ypos>
DISPlay:WAVeform<n2>:OCURsor:SETTo:YPOS <ypos>
DISPlay:WAVeform<n2>:XCURsor:SETTo:YPOS <ypos>
DISPlay:BARGraph<n2>:OCURsor:SETTo:YPOS <ypos>
DISPlay:BARGraph<n2>:XCURsor:SETTo:YPOS <ypos>
DISPlay:SWEep<n2>:OCURsor:SETTo:YPOS <ypos>
DISPlay:SWEep<n2>:XCURsor:SETTo:YPOS <ypos>

Corresponds to the softkey operation:

Cursor

Set O cursor | Set X cursor,

Value

Parameters:

<ypos> float

Sets O cursor | X Cursor to the defined value, if a horizontal cursor is involved.
The unit in which the value is entered depends on the unit of the Y-axis.

Example:
```
DISPlay:WAVeform:XCURsor:SETTo:YPOS -110 DBV
```

DISPlay:FFT<n2>:OCURsor:STATe <state>
DISPlay:FFT<n2>:XCURsor:STATe <state>
DISPlay:WAVeform<n2>:OCURsor:STATe <state>
DISPlay:WAVeform<n2>:XCURsor:STATe <state>
DISPlay:BARGraph<n2>:OCURsor:STATe <state>
DISPlay:BARGraph<n2>:XCURsor:STATe <state>
DISPlay:SWEep<n2>:OCURsor:STATe <state>
DISPlay:SWEep<n2>:XCURsor:STATe <state>

Corresponds to softkey operation:

Cursor

O cursor | X cursor,

O active | X active

Parameters:

<state> OFF | ACTive | INACtive

OFF
O cursor | X cursor off

ACTive
O cursor | X cursor is visible as a solid line and is controlled via TAB and SHIFT+TAB.

INACtive
O cursor | X cursor is visible as a dotted line and can not be controlled.

Example:
```
DISPlay:BARGraph:OCURsor:STATe OFF
DISPlay:BARGraph2:XCURsor:STATe ACTive
```

DISPlay:FFT<n2>:OCURsor:Y?
DISPlay:FFT<n2>:XCURsor:Y?
DISPlay:WAVeform<n2>:OCURsor:Y?
DISPlay:WAVeform<n2>:XCURsor:Y?
DISPlay:BARGraph<n2>:OCURsor:Y?
DISPlay:BARGraph<n2>:XCURsor:Y?

DISPlay:SWEep<n2>:OCURsor:Y?
DISPlay:SWEep<n2>:XCURsor:Y?

No corresponding function in the softkey menu.

Return values:

<argument> float

Return value:
Reads the current value of the O cursor or X cursor. The return value is a pure numeric value without unit.The numeric value is returned in the unit in which the Y-axis is displayed.

Example:
```
DISPlay:SWEep:OCURsor:Y
DISPlay:SWEep:XCURsor:Y
```
Response:-19.4783

Usage: Query only

7.26 Transferring trace data

Transferring trace data from a controller via the IEC/IEEE bus to the Audio Analyzer allows you to display externally generated or manipulated trace data with the graphical display capabilities of the Audio Analyzer.

Example:

Assume that a fast frequency response measurement using a multisine signal and an FFT has been programmed in a K1 macro. The FFT shows different high lines in the multisine frequencies, with a noise floor between.

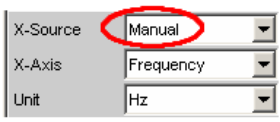
This is not the usual display mode of a frequency response curve.

The K1 macro now generates a sweep trace data set from the levels of the individual bins and their frequency values. This data set is transferred to the Audio Analyzer and is shown in the graphical display as a sweep trace, and thus as a frequency response curve.

When transferring trace data, pure numeric values without units are transferred. Thus, the presetting of the graph must precede the data transfer, and it determines the unit in which the values are interpreted. The number of the transferred X values should also comply with the currently set X-axis of the graphical display.

The transfer of data for the X-axis (…:AX and …:BX) is reserved exclusively for the sweep subsystem!

"X-Source" must be set to "Manual".



The Y-axes (…:AY and …:BY) can be transferred for all subsystems without exception.

The output of trace data with the according TRACe:<subsystem>:LOAD commands is described in chapter 7.5.4, "Output of Trace Data Sets", on page 707

- TRACe:BARGraph<n2>:STORe:AY on page 788
- TRACe:BARGraph<n2>:STORe:BY on page 788
- TRACe:FFT<n2>:STORe:AY on page 789
- TRACe:FFT<n2>:STORe:BY on page 789
- TRACe:SWEep<n2>:STORe:AX on page 788
- TRACe:SWEep<n2>:STORe:AY on page 788
- TRACe:SWEep<n2>:STORe:BX on page 788
- TRACe:SWEep<n2>:STORe:BY on page 788
- TRACe:WAVeform<n2>:STORe:AY on page 789
- TRACe:WAVeform<n2>:STORe:BY on page 789

TRACe:SWEep<n2>:STORe:AX <ax>
TRACe:SWEep<n2>:STORe:AY <ay>
TRACe:SWEep<n2>:STORe:BX <bx>
TRACe:SWEep<n2>:STORe:BY <by>

Command for saving sweep graph trace data sets.

AX designates the X-axis of trace A

AY designates the Y-axis of trace A

BX designates the X-axis of trace B

BY designates the Y-axis of trace B

In the case of a multiscan display or single display with "MIN/MAX" traces, the command DISPlay:SWEep<n2>:SCANoffset on page 710 selects the desired scan.

Suffix:
<n2> subsystem number 1 to 4

Parameters:
<by> float

Example: TRAC:SWEep1:STORe:AY <n,n,n,n>
Saves the data of the Y-axis for channel A in the first sweep system.

TRACe:BARGraph<n2>:STORe:AY <ay>
TRACe:BARGraph<n2>:STORe:BY <by>

Commands for saving bargraph trace data sets.

Commands ...:AX and ..:BX are not allowed, because they are only available for sweeps.

Suffix:
<n2> subsystem number 1 and 2

Parameters:
<by> float

TRACe:FFT<n2>:STORe:AY <ay>
TRACe:FFT<n2>:STORe:BY <by>

Commands for saving FFT graph trace data sets.

Commands `...:AX` and `..:BX` are not allowed.

Suffix:
<n2> subsystem number 1 and 2

Parameters:
<by> float

TRACe:WAVeform<n2>:STORe:AY <ay>
TRACe:WAVeform<n2>:STORe:BY <by>

Commands for saving waveform trace data sets.

Commands `...:AX` and `..:BX` are not allowed.

Suffix:
<n2> subsystem number 1

Parameters:
<by> float

7.27 User-definable data buffers

The available data buffers are mainly used for communicating between K1 macros and IEC/IEEE bus control programs.

The K1 macro or the IEC/IEEE bus control program saves data in the form of strings or binary data in the available data buffers, from where it can be collected and further processed by the other program. However, these buffers can also be used as data buffers within one of the programs.

- `SYSTem:MEMory:DATA<n3>` on page 790
- `SYSTem:MEMory:FREE` on page 790
- `SYSTem:MEMory:STRing<n3>` on page 790

SYSTem:MEMory:DATA<n3> <data>

Stores up to 16 data sets with a length limited only by the storage capacity made available by the operating system. The available storage capacity cannot be determined exactly but is usually in the range of 128 Mbytes. Preference should be given to this memory when saving trace data.

Suffix:

<n3> 1 to 16
16 data sets

Parameters:

<data> float

Numeric strings consisting of floating-point values without a unit in ASCII format
or
Binary data set of the form
#<LengthOfLength><Length><Binary data>

If the contents of the data buffer are deleted with command `SYSTem:MMEMory:FREE DATA`, The query `SYSTem:MMEMory:DATA<n3>?` returns <3.40282E+38> (NAN = Not a Number) .

Example: `SYST:MEM:DATA11 1.2345,2.3456,3.4567,4.5678`
or
`SYST:MEM:DATA11 #212<Binary data set consisting of 12 bytes>`

SYSTem:MEMory:FREE <free>

The command deletes the contents of the string or data buffer.

Parameters:

<free> STRing | DATA

STRing
deletes the contents of **all** string buffers.
After deletion, the query `SYSTem:MMEMory:STRing<n3>?` returns the string <empty> .

DATA
deletes the contents of **all** data buffers.
After deletion, the query `SYSTem:MMEMory:DATA<n3>?` returns <3.40282E+38> (NaN = Not a Number).

Usage: Setting only

SYSTem:MEMory:STRing<n3> <string>

Enters a string in the string buffer.Any strings up to a length of 540 bytes can be cached in up to 1024 memory locations.

Suffix:
<n3> 1 to 1024
1024 memory locations

Parameters:
<string> string
The maximum string length is 540 bytes.
If the contents of the string buffer are deleted with command `SYSTem:MMEMory:FREE STRing`, the query `SYSTem:MMEMory:STRing<n3>?` returns the string <empty>.

Example:
```
SYSTem:MEMory:STRing10 "Store this string in the buffer!"
```
Query:
```
SYSTem:MEMory:STRing10?
```
Response:
```
"Store this string in the buffer!"
```

7.28 Hardcopy

The `HARDcopy` commands are used for printing and saving of screenshots.

- `HCOPy:DESTination` on page 791
- `HCOPy:FILE` on page 791
- `HCOPy:FILE:MODE` on page 792
- `HCOPy[:IMMediate]` on page 792
- `HCOPy:GSIZe` on page 792
- `HCOPy:PRINter:ADDition` on page 792
- `HCOPy:PRINter:FOOTer` on page 793
- `HCOPy:PRINter:HEADer` on page 792
- `HCOPy:PRINter:ORIentation` on page 792
- `HCOPy:SOURce` on page 792

HCOPy:DESTination <destination>

Parameters:
<destination> PRINter | FILE | CLIPboard

Manual operation: See "Destination" on page 472

HCOPy:FILE <file>

Parameters:
<file> <file name>

Manual operation: See "File Name" on page 474

HCOPy:FILE:MODE <mode>

Parameters:
<mode> NEW | OVERwrite | INCRement

Manual operation: See "Store Mode" on page 473

HCOPy[:IMMediate]

Usage: Event

HCOPy:SOURce <source>

Parameters:
<source> WINDow | GRAPhics

Manual operation: See "Source" on page 471

HCOPy:GSIZe <gsize>

Parameters:
<gsize> string

Example: `HCOPy:GSIZe '800x600'`

Manual operation: See "Graph Size" on page 472

HCOPy:PRINter:ORIentation <orientation>

Parameters:
<orientation> selection

Manual operation: See "Orientation" on page 473

HCOPy:PRINter:ADDition <addition>

Parameters:
<addition> integer | ON | OFF

Manual operation: See "Header Footer " on page 473

HCOPy:PRINter:HEADer <header>

Parameters:
<header> string

Manual operation: See "Define Header" on page 473

HCOPy:PRINter:FOOTer <footer>

Parameters:
<footer> string

Manual operation: See "Define Footer" on page 473

7.29 MMEMory Subsystem

The MMEMory subsystem (**M**ass **Mem**ory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

The various drives can be selected using the "mass storage unit specifier " <msus>. The internal hard disk is selected with `D:\`, and a memory stick plugged in at the USB interface with `E:\`. The resources of a network can also be selected with <msus> in the syntax of the respective network, e.g. using the UNC format (Universal Naming Convention): `\\server\share`.

The default drive is determined using the command `MMEMory:MSIS <msus>`.

The `C:` drive is a protected system drive. This drive should not be accessed. Reconstruction of the system partition will not be possible without loss of data.

Further `MMEMory` commands are described thgether with the commands of the associated function, e.g. loading of specific instrument configurations.

7.29.1 File Naming Conventions

To enable files in different file systems to be used, the following file naming conventions should be observed.

The file name can be of any length and no distinction is made between uppercase and lowercase letters. The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). Where possible, special characters should not be used. Use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved by the operating system, e.g. CLOCK$, CON, AUX, COM1...COM4, LPT1...LPT3, NUL and PRN.

In the R&S UPP all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot.

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the file name. "*.*" therefore stands for all the files in a directory.

When used in conjunction with the commands, the parameter <file_name> is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and file name, or only the file name. The file name

must include the file extension. The same applies for the parameters <directory_name> and <path>. Depending on how much information is provided, either the values specified in the parameter or the values specified with the commands MMEM:MSIS (default drive) and MMEM:CDIR (default directory) are used for the path and drive setting in the commands.

In the example below, the current instrument setting is always stored in the file 'test1.set' in the directory 'user' on the internal hard disk.

Example:

```
MMEM:STOR:STAT "d:\user\test1.set"
```

If the complete path including the drive letter is specified, the file is stored in the specified path.

```
MMEM:MSIS 'D:'
MMEM:STOR:STAT "\user\test1.set"
```

If the parameter only contains the path and file name, the default drive set with the MMEM:MSIS command is effective.

If the parameter contains only the path and file name, the default drive defined with the command MMEM:MSISis used.

```
MMEM:MSIS 'D:'
MMEM:CDIR 'user'
MMEM:STOR:STAT 'test1.set'
```

If the parameter contains only the file name, the file is stored on the default drive MMEM:MSIS and in the default directory that was selected with the command MMEM:CDIR.

In all commands for data transmission, the data for both paths is always transmitted simultaneously.

7.29.2 Load and store setups

In all commands for data transmission, the data for both paths is always transmitted simultaneously.

- MMEMory:LOAD:STATe on page 794
- MMEMory:STORe:STATe on page 795

MMEMory:LOAD:STATe <file>

This command loads the specified instrument setting

Loading a setup overwrites the settings of the instrument with the settings that were active when setup was saved. Depending on the type of setup to be loaded, only the current settings are overwritten ("current" setup") or the entire settings, including the position and size of all windows in all screens ("complete" setup). Windows that were open when the setup was saved are opened, and windows that were closed when the setup was saved are closed again. This is also done for the screens that are not visible.

Parameters:

<file> string

file name where the setup was stored by `MMEMory:STORe:STATe`

MMEMory:STORe:STATe <file name>

Saving a setup in a 'setupfile'.

Parameters:

<file name> string

Specifies the file name in which the setup is stored. The file extension defines the type of setup that is stored:
Complete setups are stored if file extension `.set` is used. With complete setups, the entire instrument settings, plus the position and size of all windows in all screens is stored.
Current setups are stored if file extension `.sac` is used. With current setups only the instrument settings are saved. Therefore, current setups can be loaded much faster, since the panels do not have to be restored.

Usage: Event

7.29.3 Common MMEMory commands

- `MMEMory:COPY` on page 795
- `MMEMory:DATA` on page 796
- `MMEMory:MDIRectory` on page 797
- `MMEMory:MOVE` on page 797

MMEMory:COPY <source>,[<destination>]

This command copies the first specified file to the second specified file. You can also use this command to copy a complete directory, including all of its files, rather than a single file.

If you do not specify <destination>, <source> will be copied to the `MMEM:MSIS` drive and to the `MMEM:CDIR` directory. Any files in the destination directory that have the same name will be overwritten without an error message being generated.

You can also enter the path specification by using an additional parameter. The command will then read as follows: `MMEMory:COPY <file_source><msus_source>[,<file_destination>, <msus_destination>]`

The command triggers an event and therefore has no query form and no *RST value.

Example: `MMEM:COPY 'D:/user/test1.set','E:/'`
Copies the file '`test1.set`' located in the `USER` directory of the internal hard disk to the memory stick using the same name

---

MMEMory:DATA <file_name>[,<binary block data>]

This command copies the block data <binary block data> to the file designated with <file_name>.

The R&S UPP accepts the line message EOI and/or the ASCII character NL (0Ah) as an indication that data transmission has been completed.

The binary data stream must be concluded with EOI or NL or EOI followed by NL. If the data stream is not concluded with either EOI or NL, the R&S UPP will wait for additional data. In the case of a binary data transmission, the R&S UPP ignores the bit combination NL (0Ah) within the data stream.

The associated query command transmits the specified file from the R&S UPP to the controller via the IEC/IEEE bus. Make sure that the buffer on the controller is large enough to hold the file.

You can use this command to read stored instrument settings, trace files, waveform files, filter coefficient files, etc, directly from the R&S UPP or to transmit them directly to the R&S UPP.

The binary data block has the following structure: #<LengthofLength><Length><block_data>.

Example: #234<block_data># always introduces the binary block

<LengthofLength> specifies how many positions the subsequent length specification occupies (two in the example)

<Length> specifies the number of subsequent bytes (34 in the example)<binary block data> binary block data of the specified length

Example: `MMEM:DATA 'TEST1.WV',#3767<binary data>`
Writes the block data to file '`test1.wv`'.
`MMEM:DATA? 'TEST1.WV'`
transmits the data of file'`Test1.wv`' as binary block from the R&S UPP to the controller.

MMEMory:DELete <file_name>

This command deletes the specified file.

Example: `MMEM:DEL 'D:\UPV\USER\TEST1.set'`
Deletes file '`Test1.set`' from directory `USER` on the internal hard disk.

Usage: Event

MMEMory:MDIRectory <directory_name>

This command creates a new subdirectory for the specified directory. If no directory is specified, a subdirectory of the default directory is created. A directory tree can also be created by using this command

Example: `MMEM:MDIR 'carrier'`
Creates subdirectory 'carrier' in the current directory.

Usage: Event

MMEMory:MOVE
<file_source><msus_source>[,<file_destination>,<msus_destination>]

This command renames an existing file if <file_destination> does not contain a path specification. Otherwise, the file is moved to the specified path and stored under the original file name or under a new file name if one is specified.

You can also enter the path specification by means of an additional parameter; the command then reads as follows: `MMEMory:MOVE <file_source><msus_source>[,<file_destination>, <msus_destination>]`

Example: `MMEM:MOVE 'test.set','keep.set'`
Renames file '`test.set`' to '`keep.set`'.
`MMEM:MOVE 'test.set','\user\keep.set`
Moves file '`test.set`' to subdirectory '`user`' and stores it there under the name '`keep.set`'

Usage: Event

7.30 STATus Subsystem

This system contains the commands for the status reporting system. *RST has no effect on the status registers.

Queries return the current value of the respective register, which permits a check of the device status. A decimal value between 0 and 32767 (=215-1) is returned.

The configuration commands set the respective register thus determining which status changes of the R&S UPP causes the status registers to be changed.

STATus:OPERation STATus:QUEStionable STATus:XQUEstionable	Returns and sets a decimal value between 0 and 32767 (= 2^15 − 1). The most significant bit is set to zero in all registers. The register content can thus always be interpreted as a positive integer.
STATus:QUEStionable:UNDERrange STATus:QUEStionable:OVERrange STATus:QUEStionable:MEASuring	Returns and sets a decimal value between 0 and 65535 (= 2^16 − 1). For future applications, the most significant bit d15 may also be set.

- STATus:PRESet on page 799
- STATus:OPERation:CONDition? on page 799
- STATus:OPERation:ENABle on page 799
- STATus:OPERation:EVENt? on page 799
- STATus:OPERation:NTRansition on page 800
- STATus:OPERation:PTRansition on page 800
- STATus:QUEStionable:CONDition? on page 800
- STATus:QUEStionable:ENABle on page 800
- STATus:QUEStionable:EVENt? on page 801
- STATus:QUEStionable:NTRansition on page 801
- STATus:QUEStionable:PTRansition on page 801
- STATus:QUEStionable:MEASuring:CONDition? on page 804
- STATus:QUEStionable:MEASuring:ENABle on page 804
- STATus:QUEStionable:MEASuring:EVENt? on page 805
- STATus:QUEStionable:MEASuring:NTRansition on page 805
- STATus:QUEStionable:MEASuring:PTRansition on page 805
- STATus:QUEStionable:OVERrange:CONDition? on page 803
- STATus:QUEStionable:OVERrange:ENABle on page 803
- STATus:QUEStionable:OVERrange:EVENt? on page 803
- STATus:QUEStionable:OVERrange:NTRansition on page 804
- STATus:QUEStionable:OVERrange:PTRansition on page 804
- STATus:QUEStionable:UNDerrange:CONDition? on page 801
- STATus:QUEStionable:UNDerrange:ENABle on page 802
- STATus:QUEStionable:UNDerrange:EVENt? on page 802
- STATus:QUEStionable:UNDerrange:NTRansition on page 802
- STATus:QUEStionable:UNDerrange:PTRansition on page 803
- STATus:QUEue:NEXT? on page 807
- STATus:XQUEstionabl:CONDition? on page 805
- STATus:XQUEstionabl:ENABle on page 806

- STATus:XQUEstionabl:EVENt? on page 806
- STATus:XQUEstionabl:NTRansition on page 806
- STATus:XQUEstionabl:PTRansition on page 806

STATus:PRESet

The command resets the status registers.

STATus:OPERation STATus:QUEStionable STATus:XQUEstionable	All PTRansition parts are set to 7FFFh (32767), i.e. all transitions from 0 to 1 are detected.
STATus:QUEStionable:UNDERrange STATus:QUEStionable:OVERrange STATus:QUEStionable:MEASuring	All PTRansition parts are set to FFFFh (65535) , i.e. all transitions from 0 to 1 are detected.

The NTRansition parts of all status registers are set to 0, i.e. a transition from 1 to 0 of a CONDition bit is not detected. The ENABle parts of all status registers are set to 0, i.e. none of the events in these registers is passed on.

The command triggers an event and therefore has no query form and no *RST value.

STATus:OPERation:CONDition?

The command queries the content of the CONDition part of the STATus:OPERation register.

This part contains the information about the current instrument state.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:OPERation:ENABle <integer>

The command sets the bits of the ENABle part of the STATus:OPERation register. This setting determines which events of the EVENt part of the STATus:OPERation register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Parameters:
<integer> 0...32767

STATus:OPERation:EVENt?

The command queries the content of the EVENt part of the STATus:OPERation register. This part contains the information about the current instrument state since the last readout.

A bit set in the EVENt register indicates a change of the corresponding bit in the CONDition register. Whether bits in the EVENt register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the PTRansition and the NTRansition registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:OPERation:NTRansition <integer>

The command sets the bits of the NTRansition part of the STATus:OPERation register. A bit set in the NTRansition register causes a bit transition from 1 to 0 in the CONDition register to produce an entry in the EVENt register.

Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:OPERation:PTRansition <integer>

The command sets the bits of the PTRansition part of the STATus:OPERation register. A bit set in the PTRansition register causes a bit transition from 0 to 1 in the CONDition register to produce an entry in the EVENt register. Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:QUEStionable:CONDition?

The command queries the content of the CONDition part of the STATus:QUEStionable register. This part contains the information about the current instrument state.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:ENABle <integer>

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This setting determines which events of the EVENt part of the STATus:QUEStionable register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Parameters:
<integer> 0...32767

STATus:QUEStionable:EVENt?

The command queries the content of the `EVENt` part of the `STATus:QUEStionable` register. This part contains the information about the current instrument state since the last readout.

A bit set in the `EVENt` register indicates a change of the corresponding bit in the `CONDition` register. Whether bits in the `EVENt` register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the `PTRansition` and the `NTRansition` registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:NTRansition <integer>

The command sets the bits of the `NTRansition` part of the `STATus:QUEStionable` register. A bit set in the `NTRansition` register causes a bit transition from 1 to 0 in the `CONDition` register to produce an entry in the `EVENt` register.

Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:QUEStionable:PTRansition <integer>

The command sets the bits of the `PTRansition` part of the `STATus:QUEStionable` register. A bit set in the `PTRansition` register causes a bit transition from 0 to 1 in the `CONDition` register to produce an entry in the `EVENt` register.

Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:QUEStionable:UNDerrange:CONDition?

The command queries the content of the `CONDition` part of the `STATus:QUEStionable:UNDERrange` register. This part contains the information about which channel of a multichannel instrument is underranged.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:UNDerrange:ENABle <integer>

The command sets the bits of the `ENABle` part of the `STATus:QUEStionable:UNDERrange` register. This setting determines which events of the status-event part are to be passed on to summary bit 2 of the `STATus:QUEStionable` register. These events can be used to trigger a service request.

Parameters:
<integer> 0...65535

STATus:QUEStionable:UNDerrange:EVENt?

The command queries the content of the `EVENt` part of the `STATus:QUEStionable:UNDERrange` register. This part contains the information about the current instrument state since the last readout.

A bit set in the `EVENt` register indicates a change of the corresponding bit in the `CONDition` register. Whether bits in the `EVENt` register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the `PTRansition` and the NTRansition registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:UNDerrange:NTRansition <integer>

The command sets the bits of the `NTRansition` part of the `STATus:QUEStionable:UNDERrange` register. A bit set in the `NTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:QUEStionable:UNDerrange:PTRansition <integer>

The command sets the bits of the `PTRansition` part of the `STATus:QUEStionable:UNDERrange` register. A bit set in the `PTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:QUEStionable:OVERrange:CONDition?

The command queries the content of the `CONDition` part of the `STATus:QUEStionable:OVERrange` register. This part contains the information about which channel of a multichannel instrument is overranged.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:OVERrange:ENABle <integer>

The command sets the bits of the `ENABle` part of the `STATus:QUEStionable:OVERrange` register. This setting determines which events of the status-event part are to be passed on to summary bit 1 of the `STATus:QUEStionable` register. These events can be used to trigger a service request.

Parameters:
<integer> 0...65535

STATus:QUEStionable:OVERrange:EVENt?

The command queries the content of the `EVENt` part of the `STATus:QUEStionable:OVERrange` register. This part contains the information about the current instrument state since the last readout.

A bit set in the `EVENt` register indicates a change of the corresponding bit in the `CONDition` register. Whether bits in the `EVENt` register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the `PTRansition` and the `NTRansition` registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:OVERrange:NTRansition <integer>

The command sets the bits of the `NTRansition` part of the `STATus:QUEStionable:OVERrange` register. A bit set in the `NTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:QUEStionable:OVERrange:PTRansition <integer>

The command sets the bits of the `PTRansition` part of the `STATus:QUEStionable:OVERrange` register. A bit set in the `PTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:QUEStionable:MEASuring:CONDition?

The command queries the content of the `CONDition` part of the `STATus:QUEStionable:MEASuring` register. This part contains the information about which channel of a multichannel instrument is activated or deactivated.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:MEASuring:ENABle <integer>

The command queries the content of the `ENABle` part of the `STATus:QUEStionable:MEASuring` register. This setting determines which events of the status-event part are to be passed on to summary bit 0 of the `STATus:QUEStionable` register. These events can be used to trigger a service request.

Parameters:
<integer> 0...65535

STATus:QUEStionable:MEASuring:EVENt?

The command queries the content of the `EVENt` part of the `STATus:QUEStionable:MEASuring` register. This part contains the information about the current instrument state since the last readout.

A bit set in the `EVENt` register indicates a change of the corresponding bit in the `CONDition` register. Whether bits in the `EVENt` register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the `PTRansition` and the `NTRansition` registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:QUEStionable:MEASuring:NTRansition <integer>

The command sets the bits of the `NTRansition` part of the `STATus:QUEStionable:MEASuring` register. A bit set in the `NTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:QUEStionable:MEASuring:PTRansition <integer>

The command sets the bits of the `PTRansition` part of the `STATus:QUEStionable:MEASuring` register. A bit set in the `PTRansition` part causes a bit transition from 1 to 0 in the `CONDition` part to produce an entry in the `EVENt` part of the register.

Reading the information does not clear the register.

Parameters:
<integer> 0...65535

STATus:XQUEstionabl:CONDition?

The command queries the content of the `CONDition` part of the `STATus:XQUEStionable` register. This part contains the information about the current instrument state.

Reading the information does not clear the register.

Return values:
<argument> integer

Usage: Query only

STATus:XQUEstionabl:ENABle <integer>

The command sets the bits of the `ENABle` part of the `STATus:XQUEstionable` register. This setting determines which events of the `EVENt` part of the `STATus:XQUEStionable` register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Parameters:
<integer> 0...32767

STATus:XQUEstionabl:EVENt?

The command queries the content of the `EVENt` part of the `STATus:XQUEStionable` register. This part contains the information about the current instrument state since the last readout.

A bit set in the `EVENt` register indicates a change of the corresponding bit in the `CONDition` register. Whether bits in the `EVENt` register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the `PTRansition` and the `NTRansition` registers.

Reading the information clears the register.

Return values:
<argument> integer

Usage: Query only

STATus:XQUEstionabl:NTRansition <integer>

The command sets the bits of the `NTRansition` part of the `STATus:XQUEStionable` register. A bit set in the `NTRansition` register causes a bit transition from 1 to 0 in the `CONDition` register to produce an entry in the `EVENt` register.

Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:XQUEstionabl:PTRansition <integer>

The command sets the bits of the `PTRansition` part of the `STATus:XQUEStionable` register. A bit set in the `PTRansition` register causes a bit transition from 0 to 1 in the `CONDition` register to produce an entry in the `EVENt` register.

Reading the information does not clear the register.

Parameters:
<integer> 0...32767

STATus:QUEue:NEXT?

This command is identical to the `SYSTem:ERRor` command

Return values:
<argument> integer

Usage: Query only

7.31 SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions.

- `SYSTem:CASCade:PORTno` on page 807
- `SYSTem:CHNString` on page 808
- `SYSTem:COMMunicate:GTL` on page 808
- `SYSTem:COMMunicate:GPIB:ADDRess` on page 808
- `SYSTem:DISPlay:EXPLanation<n3>:SHOW` on page 808
- `SYSTem:DISPlay:EXPLanation<n3>:TEXT` on page 808
- `SYSTem:DISPlay:SCPiupdate` on page 808
- `SYSTem:MAXChdisp` on page 808
- `SYSTem:PRESet` on page 809
- `SYSTem:PROGramm:EXECute` on page 809
- `SYSTem:PROFile:CLIPboard` on page 809
- `SYSTem:PROFile:FILE` on page 809
- `SYSTem:PROFile:PRINter` on page 809
- `SYSTem:PROFile:SCReen` on page 809
- `SYSTem:QLONg` on page 809
- `SYSTem:SHTDown` on page 810
- `SYSTem:VERSion?` on page 810
- `SYSTem:WINStyle` on page 811

SYSTem:CASCade:PORTno <portno>

Parameters:
<portno> integer

Manual operation: See "Casc Port No" on page 470

SYSTem:CHNString <chnstring>

Parameters:
<chnstring> string

Manual operation: See "Channel Descr." on page 475

SYSTem:COMMunicate:GTL

This command switches the instrument to local operation.

SYSTem:COMMunicate:GPIB:ADDRess <address>

This command sets the IEC/IEEE bus address.

Parameters:
<address> integer
Range: 1 to 30

Example: `SYST:COMM:GPIB:ADDR 14`
'Sets IEC/IEEE bus address to 14

Manual operation: See "GPIB Address" on page 470

SYSTem:DISPlay:EXPLanation<n3>:SHOW <show>

Parameters:
<show> string

SYSTem:DISPlay:EXPLanation<n3>:TEXT <text>

Parameters:
<text> string

SYSTem:DISPlay:SCPiupdate <scpiupdate>

Parameters:
<scpiupdate> ON | OFF

Manual operation: See "SCPI update" on page 471

SYSTem:MAXChdisp <maxchdisp>

Parameters:
<maxchdisp> integer

Manual operation: See "Max Ch Disp" on page 475

SYSTem:PRESet

This command triggers an instrument reset. The command has the same effect as "Menu, File, Preset (Load Default)", or the `*RST` command.

SYSTem:PROFile:CLIPboard <clipboard>

Parameters:
<clipboard> string

SYSTem:PROFile:FILE <file>

Parameters:
<file> string

SYSTem:PROFile:PRINter <printer>

Parameters:
<printer> string

SYSTem:PROFile:SCReen <screen>

Parameters:
<screen> string

SYSTem:PROGramm:EXECute <execute>

The command starts the specified Windows program and passes on additional call parameters. The command is normally used to remotely start Visual Basic programs in the R&S UPP-K1 software option (see also the description for the R&S UPP-K9x).

Parameters:
<execute> command line
Console command line for Windows

Example: `:SYST:PROG:EXEC 'C:\Program Files\test.exe' arg1 arg2 arg3 arg4`
starts the "`test.exe`" Windows program with the "arg1", "arg2", "arg3", and "arg4" arguments and maintains execution until the program is ended.

SYSTem:QLONg <qlong>

Parameters:
<qlong> ON | OFF

Manual operation: See "SCPI Logging/Query Longform" on page 475

SYSTem:SHUtdown <shutdown>
SYSTem:SHTDown <shtdown>

This command shuts down the R&S UPP by remote control.

The alias command is `SYSTem:SHUtdown`.

Parameters:

<shtdown> float
time until shutdown in seconds. No entry corresponds to a time of 0 seconds, i.e. immediate shutdown.

Example: `SYSTem:SHTDown`
or
`SYSTem:SHUtdown`
Shuts down the R&S UPP immediately.

Usage: Event

SYSTem:SINFo <sinfo>

Parameters:

<sinfo> string

SYSTem:SINFo:MAC <mac>

Parameters:

<mac> **String**
The MAC address (Media Access Control Address) is the hardware address of the network adapter. It identifies the instrument in the network. The address is returned as string in hexa decimal format '00:1E:C9:48:6E:60'.

SYSTem:VERSion?

This command queries the SCPI version with which the instrument is compliant. The SCPI version is returned in the form of a calendar year.

Return values:

<argument> integer

Example: `:SYST:VERS?`
Queries the SCPI version.
Response:
`1999.0`
The instrument is compliant with the 1999.0 SCPI version.

Usage: Query only

SYSTem:WINStyle <winstyle>

Parameters:
<winstyle> ON | OFF

Manual operation: See "File Selector Win Style " on page 475

8 Cascading

8.1 Overview

If a measurement application requires the synchronous analysis of more than 8 channels, cascading of several R&S UPPs is an option.

A cascade always consists of an 8-channel master R&S UPP and one or more slave instruments, which can each be equipped with 2, 4, or 8 channels.

According to a daisy chain, the instruments are provided with a uniform reference clock signal, which is distributed from the master to all connected slaves.

The communication and transfer of data between the instruments occurs via LAN.

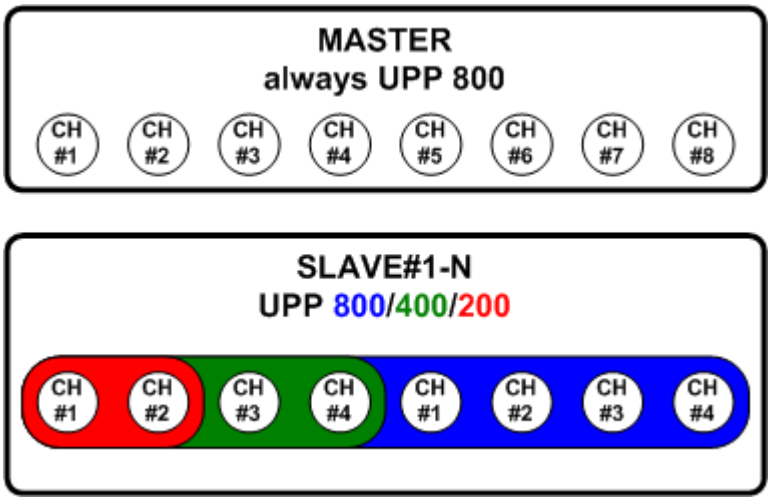
A cascade is set up by manual operation of the "CASCADE" button on the measuring instruments involved, whereas the instruments are set using the GUI of the master or by remote control of the master from a control computer via IEC/IEEE bus or LAN.

8.2 Order Code of the Instruments

To assemble a cascade, a master instrument and at least one slave are required.

Master instruments can only be 8-channel instruments of the type designation R&S UPP 800, whereas slaves can be implemented as 8 as well as 4 or 2-channel instruments in any combination.

The type designations for the 4 and 2-channel versions are R&S UPP 400 or R&S UPP200.



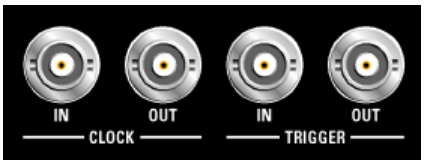
The R&S order numbers for the 2, 4, and 8-channel versions are, respectively: 1411.1003.02, 1411.1003.04, 1411.1003.08.

8.3 Wiring of a Cascade

8.3.1 Clock Lines

In a cascade, all measuring instruments involved are provided with a common reference clock signal to enable synchronous measured value acquisition. The clock signal proceeds from the master instrument and is passed from slave to slave by means of a daisy chain.

Beginning with the master, the "Clock_Out" BNC output is connected with the "Clock_In" BNC input on the rear of the next instrument in the chain.

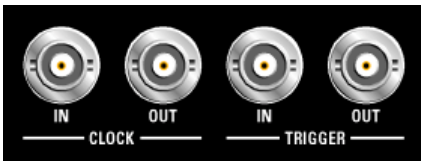


Commercially available 50 Ω BNC cables are used as connecting lines.

8.3.2 Trigger Lines

The trigger event for starting the measured value acquisition is always generated by the master instrument and also distributed by daisy chain to all connected slaves.

Beginning with the master, the "Trigger_Out" BNC output is connected with the "Trigger_In" BNC input on the rear of the next instrument in the chain.



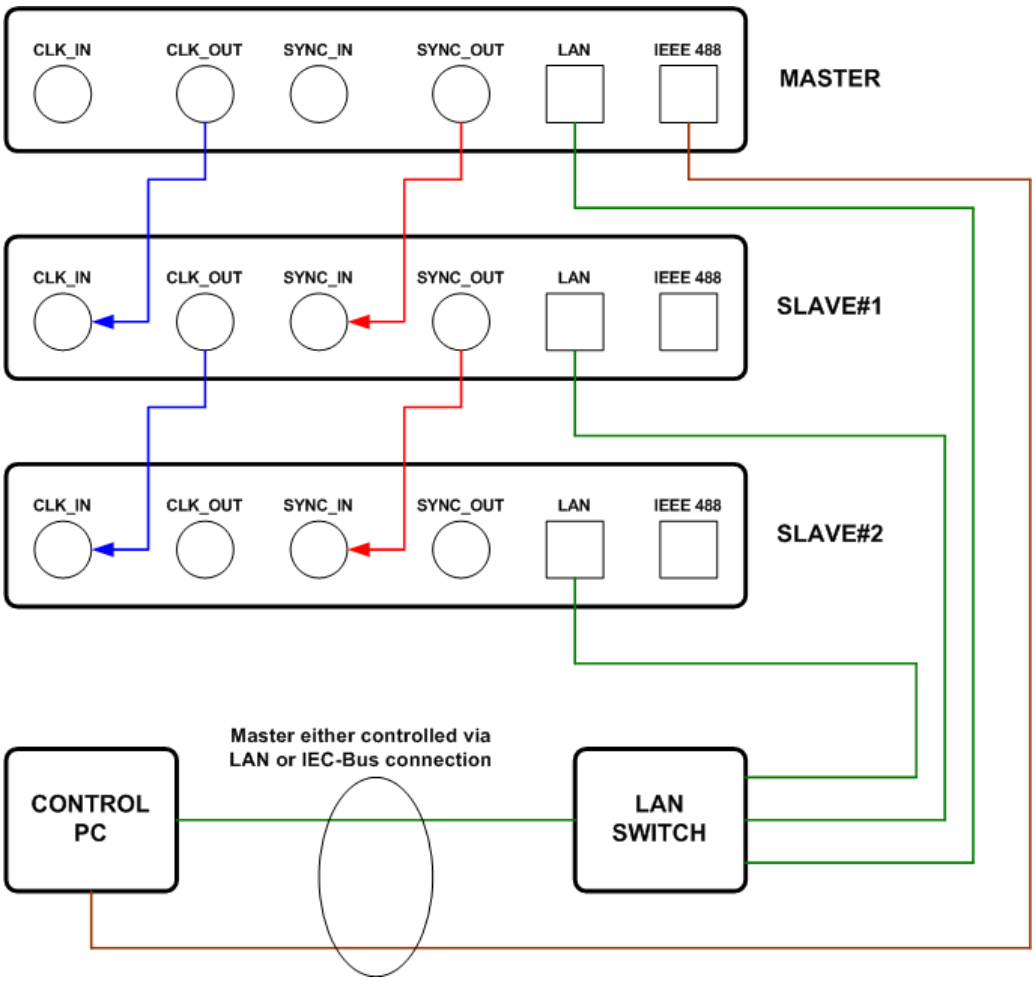
Commercially available 50 Ω BNC cables are used as connecting lines.

8.3.3 Communication Lines

All components involved are interconnected via a LAN switch for communication between the instruments and for controlling the cascade by means of a control computer.

The cascade and the setting of the individual slaves are always configured via the master R&S UPP. This can be controlled with a control computer by using either a GUI or a remote control via LAN or IEC/IEEE bus.

Commercially available accessories serve as the LAN switch and LAN Ethernet cable.

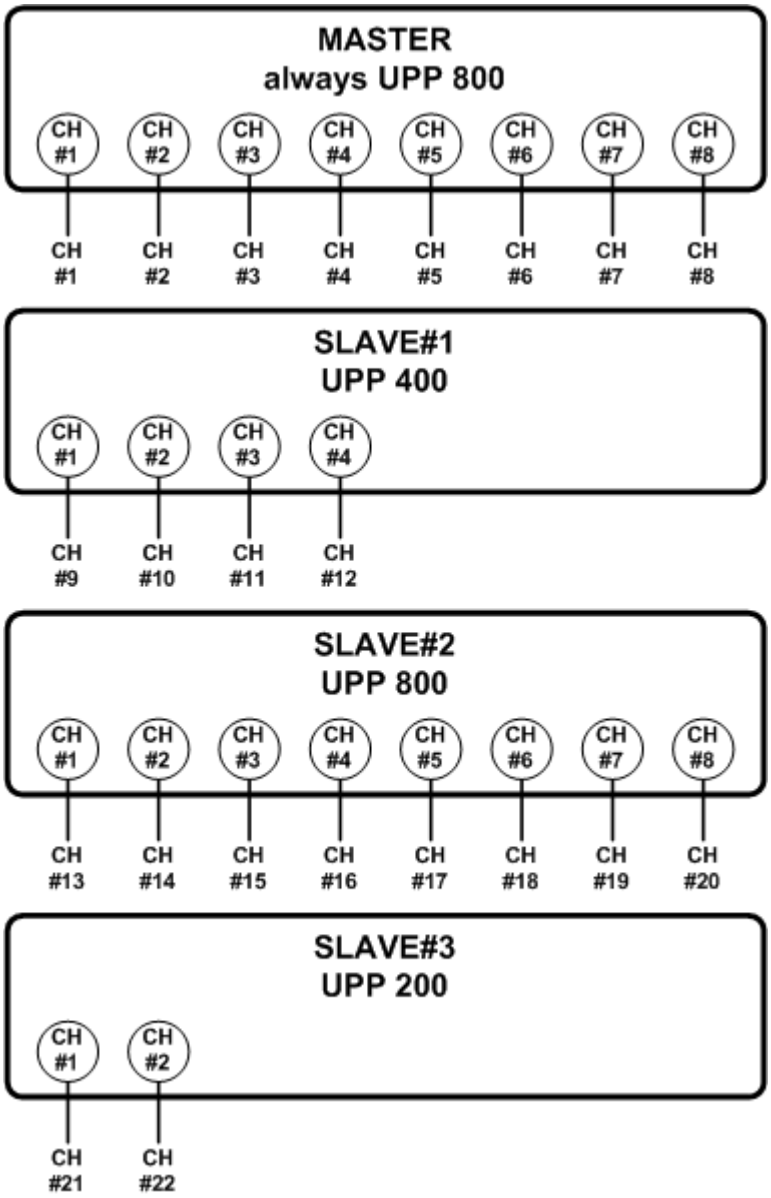


The limiting factor for the depth of a cascade is the signal delays on clock and trigger lines, which is why the shortest possible cables should be used.

The maximum depth of a cascade is 5 slaves.

8.3.4 Numbering of the Channels

Independent of the formation of a cascade with R&S UPPs of different versions (R&S UPP800, R&S UPP400, R&S UPP200), the channels are always numbered consecutively and continuously beginning with the master out to all slaves.



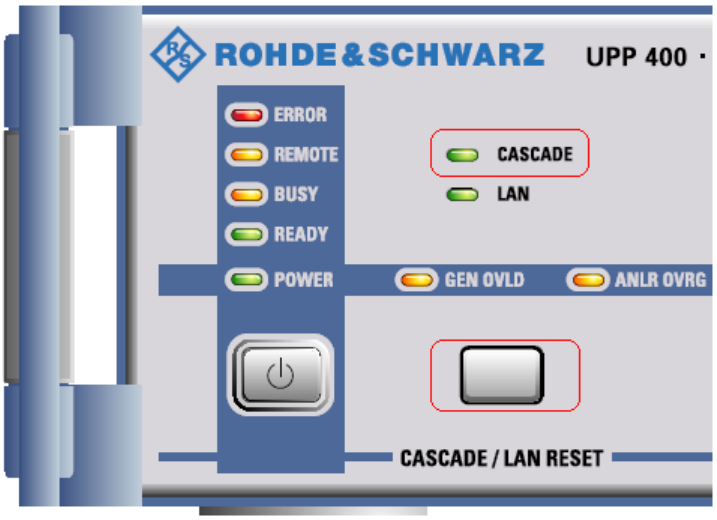
Channels that are switched off are not omitted from the numbering – they simply do not provide any measurement result (OFF appears in the numeric display, the value 9.91e +38 appears in remote operation).

8.4 Configuration of a Cascade

8.4.1 Configuration via the CASCADE Button

A cascade is configured once. The instruments involved each note their respective role (master, slave #x) after being switched off and retain their state until they are explicitly reset and reconfigured.

The individual devices are always configured via two elements on the front of the R&S UPP: The "CASCADE/LAN_RESET" button and the associated status LED.



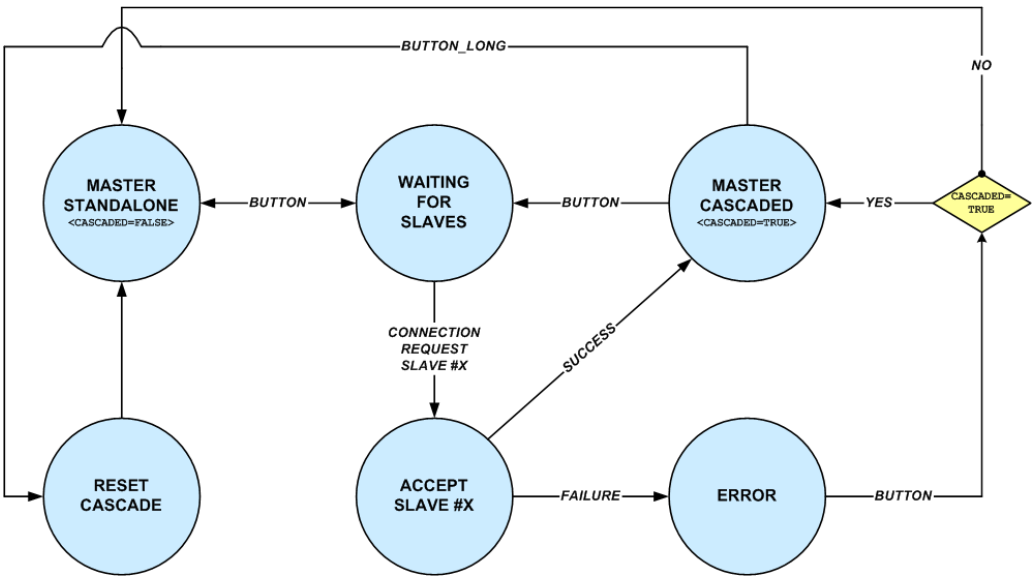
When cabling a cascade, it is already implicitly defined which instrument will assume the role of master and which instruments can function as slaves.

Each R&S UPP, that detects a clock signal at its CLK_IN BNC socket on the rear side of the instrument automatically accepts the role of an uncascaded slave, whereas each instrument without a reference clock signal present initially functions as a standalone master.

Only R&S UPP800 hardware variants with installed R&S UPP-K800 software option (audio analyzer eight channels) can take on the role of a master device!

8.4.1.1 Master instrument configuration

The programming routine is visualized using a constellation diagram by means of the "CASCADE/LAN_RESET" button. A flashing signal sequence on the "CASCADE LED" shows the user the respective instrument status. For a list of the states with the corresponding signal sequences, see chapter 8.4.1.3, "State coding", on page 818.



Every master that has never been configured before is at first in the state **MASTER_STANDALONE**.

By pressing the CASCADE button once, the state changes to **WAITING_FOR_SLAVES**, which waits for connection requests from slave instruments, the configuration of which is explained in the next chapter.

If, as described in the following, a slave is configured with a certain number within the cascade (Slave#1,Slave#2,Slave#3...), it sends a connection request to the master. Depending on whether the desired position within the cascade could be assigned, the state of the master changes to **MASTER_CASCADED** or **ERROR**.

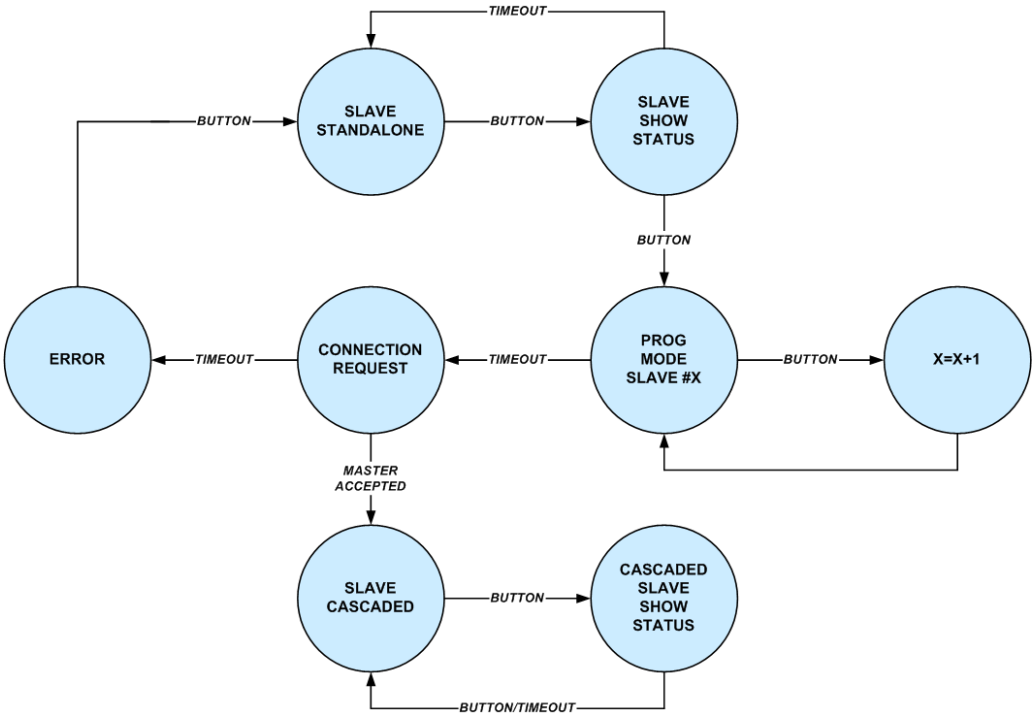
If the slave could be integrated into the cascade successfully, the internal variable **CASCADED** is set and the user returns to the **WAITING_FOR_SLAVES** state by pressing a button and can continue with the configuration of other slaves.

If the integration of a slave fails, the master passes through an **ERROR** state either into its initial state **MASTER_STANDALONE** or returns to the **MASTER_CASCADED** state in the event that at least one slave had already been received into the cascade.

By holding down the button, the user can always reset an existing cascade from the **MASTER_CASCADED** state. In this case, all instruments involved lose their cascading information and return to their initial state.

8.4.1.2 Slave instrument configuration

The programming routine is visualized using a constellation diagram by means of the "CASCADE/LAN_RESET" button. A flashing signal sequence on the "CASCADE LED" shows the user the respective instrument status. For a list of the states with the corresponding signal sequences, see chapter 8.4.1.3, "State coding", on page 818.



Every slave that has never been configured before is at first in the state **SLAVE_STANDALONE**.

By pressing the CASCADE button once, the slave changes to the state **SLAVE_SHOW_STATUS**, in which it visualizes its status (not cascaded, Slave#x) by means of a flashing signal sequence on the "CASCADE LED". After a timeout, the instrument reverts to its initial state.

By pressing the button, the user enters the programming mode. In the state **PROG_MODE_SLAVE_#X**, the position of the slave within the cascade is determined by repeatedly pressing the button. When the desired position has been reached and after a timeout, the slave changes to the **CONNECTION_REQUEST** state, in which the connection to the master is established and it is informed of the desired position within the cascade.

If the slave could not be integrated into the cascade at position #X, the state machine passes through an **ERROR** state back to the initial state.

If the master successfully receives the acknowledge signal, the slave assumes the **SLAVE_CASCADED** state and notes its position even after the instrument has been switched off, until the user decides to have the master reset the cascade.

The user can have the current status of a cascaded slave displayed at any time by pressing a button.

8.4.1.3 State coding

The current state of an instrument is displayed for the user by the "CASCADE LED", which differentiates instruments as master or slave.

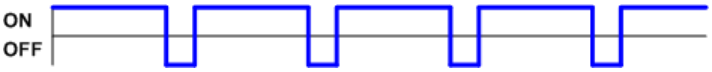
State coding: Master device

MASTER_STANDALONE

Initial state of a master instrument. So far, no slaves have been accepted into the cascade.

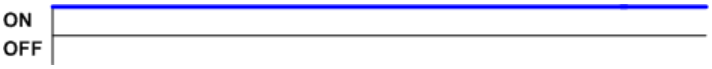
WAITING_FOR_SLAVES

Master is waiting for connection requests from slave instruments.



MASTER_CASCADED

At least one slave was successfully received into the cascade.



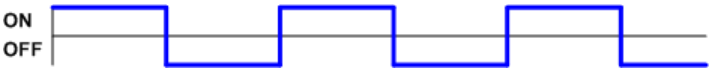
ERROR

Error condition. "ERROR" LED flashes.

State coding: Slave device

SLAVE_STANDALONE

Initial state of a slave instrument. A connection to the master has not yet been established.



SLAVE_SHOW_STATUS

Slave displays its position within the cascade.

Fig. 8-1: Not cascaded.

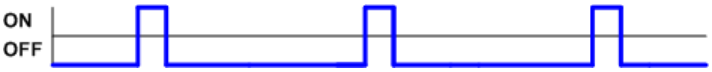


Fig. 8-2: Slave#1

Fig. 8-3: Slave#2

Fig. 8-4: Slave#3

Fig. 8-5: Slave#4

Fig. 8-6: Slave#5

PROG_MODE_SLAVE_#X

Slave starts connection request to the master for it to be received into the cascade as Slave_#X.

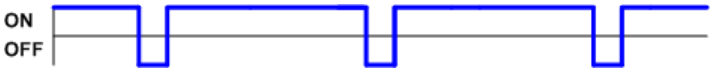


Fig. 8-7: Slave#1

Fig. 8-8: Slave#2

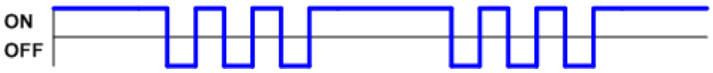


Fig. 8-9: Slave#3

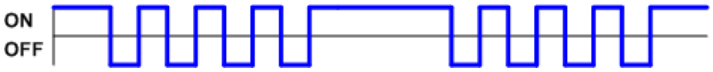


Fig. 8-10: Slave#4

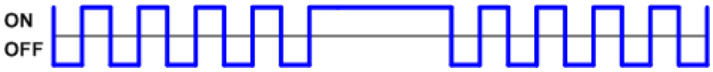
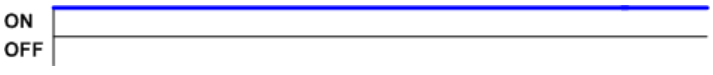


Fig. 8-11: Slave#5

SLAVE_CASCADED



CASCADED_SLAVE_SHOW_STATUS

As SLAVE_SHOW_STATUS.

ERROR

Error condition. "ERROR" LED flashes.

8.5 Operating Modes

A cascade can behave like a single R&S UPP with a correspondingly large number of channels if all instruments have identical analyzer settings and measurement functions in particular.

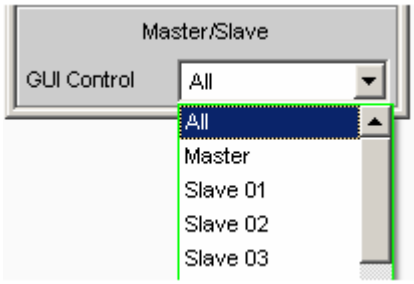
On the other hand, instruments in the cascade can also be controlled and set individually to enable multichannel measurements with different analyzer configurations.

8.6 Manual Operation of a Cascade

8.6.1 Operating Method

A master R&S UPP can be operated manually either by a connected mouse and keyboard or via remote desktop. All instruments within the cascade are configured by it, whereby the respective settings of the addressed instrument are always displayed in the user interface of the master.

You can define the devices to which the settings configured on the master are transmitted in the menu bar using the button "Utilities", "Config Panel" the panel section "Master/Slave" in the parameter field "GUI Control".



See "GUI Control" on page 476.

8.6.1.1 GUI Control ALL

Selecting "All" makes it possible to apply the settings made for the master to all slaves. This operating mode should always be used if the entire cascade is supposed to behave like an instrument with many channels.

Test Result Display

If a measurement has been started in this control mode, the measurement results of all instruments are displayed within the cascade.

NOTICE

Particularities:

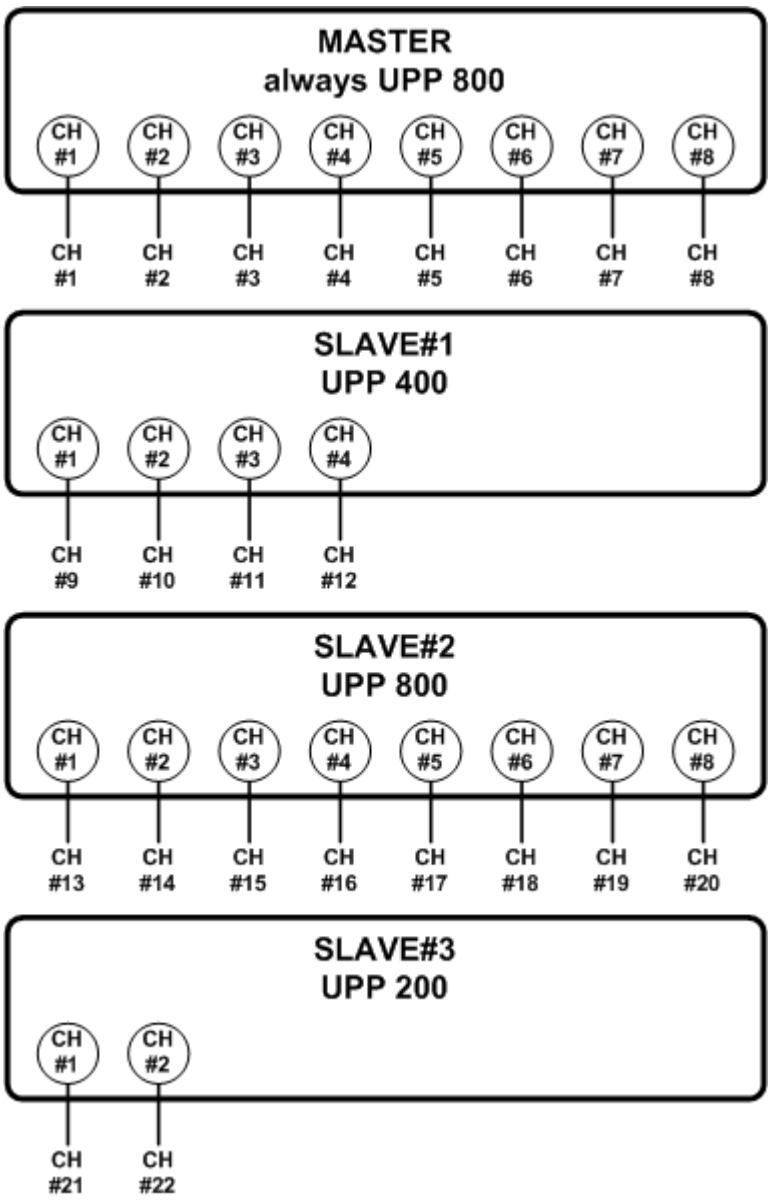
In the following, some particularities with respect to the global configuration of a cascade are mentioned.

Reference and Trigger Channel

Except for the global settings, the "Ref Channel" and "Trigger Chan" parameter fields are in the "Analyzer Config" and "Analyzer Function" panel of the analog instrument. These settings are not passed on to the slaves, since the reference and trigger channel must always be located on the master instrument.

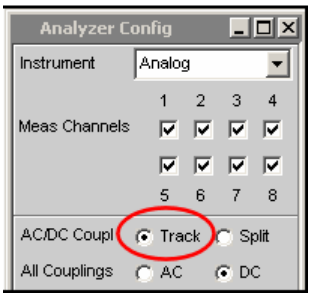
Channel selection

The channels selected in the "Analyzer Config" panel of the analog instrument (Meas Channels) are forwarded to the slaves 1:1. The logical channel number within the cascade follows from the position of the slave.

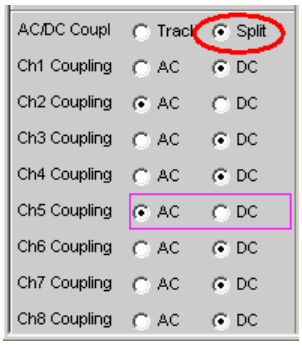


Coupling

If "AC/DC Coupl" = "Track" was selected in the "Analyzer Config" panel of the master, the "All Couplings" setting of the master is transferred to all slaves.

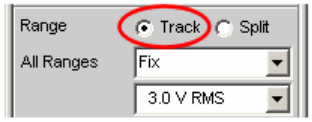


If "AC/DC Coupl" = "Split" was selected in the "Analyzer Config" panel of the master, the "Chx Coupling" settings of the master are transferred to all slaves. In order to set particular channels on the slave instruments, the "GUI Control" = "Slave XX" setting should be selected.



Range

The relationships depicted for the coupling apply in like manner also for "Range" "Track | Split".



If the instruments of a cascade behave largely like an instrument with many channels but slightly different channel settings, then use "GUI Control" = "All" to configure the default setting for the coupling and range per track, in order to set the exceptions for the individual slaves afterwards with "GUI Control" = "Slave XX".

8.6.1.2 GUI Control Master

The operation refers only to the master. All settings concerning the analyzer and the measurement function have only a local effect on the master.

Test Result Display

If a measurement has been started in this control mode, the measurement results of all instruments are displayed within the cascade.

8.6.1.3 GUI Control Slave xx

Settings in the GUI of the master have a direct effect on a particular slave. If the selected slave is not in the cascade, there is an error message.

The setting options of the selected slave are mirrored in the user interface of the master, so that it looks to the user as if he or she is operating the slave directly. Panels that are not supported with the cascading appear grayed out. Every operation carried out

on the master is immediately transferred to the selected slave, so that its hardware is simultaneously set.

Test Result Display

If a measurement has been started in this control mode, the measurement results of all instruments are displayed within the cascade.

8.7 Remote Control

8.7.1 Operating the Slave from the Master

As also with the manual operation, the entire cascade is controlled from the master. The master is connected to a control computer via LAN or IEC/IEEE bus and controls its slaves via LAN connection fully automatically.

8.7.2 Distribution of SCPI Commands in a Cascade

The SCPI command `CASCade:ASSignment ALL | MASTer | SLAVexx` determines whether subsequent commands are meant for all instruments or for a particular instrument in the cascade.

8.7.2.1 CASCade:ASSignment ALL

There are two types of commands: Commands not addressing a specific channel and commands addressing a specific channel.

Commands Not Addressing a Specific Channel

After the command `CASCade:ASSignment ALL`, all subsequent commands are sent to all instruments in the cascade.

Example:

```
CASCade:ASSignment ALL
SENSe:FUNCtion RMS
```

The RMS measurement function is set in the master and in all slaves.

Commands Addressing a Specific Channel

In the R&S UPP there are few commands that are channel-related. If the cascade is to behave as an individual instrument, thus in the operating mode `CASCade:ASSignment ALL`, these commands – without the user's help – are converted with regard to the channel number and sent to the corresponding slave. If individual instruments are directly addressed, the specified channel number <ch> for the R&S UPP200 ≤ 2, for the R&S UPP400 ≤ 4 and for the R&S UPP800 ≤ 8.

From the channel number, the master calculates either itself or one of its slaves and sends the command there with the corresponding modified channel number.

Example:

`INPut:MCHannels20ON`

If the cascade has been composed of only 8-channel instruments, this command switches on the **2nd slave** and its **channel 4**.

Command addressing a specific channel	Comment
INPut:MCHannel<ch> ON | OFF	Switch channels on/off
INPut<ch>:COUPling AC | DC	AC/DC coupling A channel specification is only significant if the associated command INPut:COUPling:CHANnels SPLit | TRACk is set to **SPLit**.
SENSe[1]:VOLTage:RANGe<ch>:MODE AUTO | FIX | LOWER	Range settings A channel specification is only significant if the associated command INPut:RANGe:CHANnels SPLit | TRACk is set to **SPLit**.
SENSe[1]:VOLTage:RANGe<ch>:VALue <nu>	
SENSe[1]:DATA<ch>?	Call up function measurement results
SENSe2:DATA<ch>?	Call up input peak measurement results
SENSe3:DATA<ch>?	Call up frequency/phase measurement results
SENSe6:DATA<ch>?	Call up level monitor measurement results

8.7.2.2 CASCade:ASSignment MASTer

The following commands are intended only for the master. Channel-related commands with a channel number ≥ 8 are refused.

Only a new `CASCade:ASSignment` command changes the forwarding of the subsequent commands.

8.7.2.3 CASCade:ASSignment SLAVe xx

The following commands are intended only for SLAVe xx. Channel-related commands with a channel number > 2 for R&S UPP200, > 4 for R&S UPP400, and > 8 for R&S UPP800 are refused.

Only a new `CASCade:ASSignment` command changes the forwarding of the subsequent commands.

8.7.3 Query Commands

8.7.3.1 Query for setting commands

CASCade:ASSignment ALL

Commands Addressing a Specific Channel

are sent from the master – without the user's help – to the corresponding instrument and that is also the source of the unique query response.

Example:

`INPut:MCHannel20?`

Response: ON

If the cascade has been composed of only 8-channel instruments, this command queries the 2nd slave and its channel 4.

Commands Not Addressing a Specific Channel

Since the option of individual control makes it possible for each instrument in the cascade to have a different setting, a query request in the operating mode `CASCade:ASSignment ALL` must generate a query response that reproduces the different settings. To satisfy this particularity in the cascading, the query responses of the individual instruments are connected with "|".

Example:

The cascade consists of a master and 2 slaves.

`OUTPut:TYPE?` contains no channel information and in operating mode `CASCade:ASSignment ALL` is sent by the master to itself and to the two slaves. All instruments respond and the response strings are strung together with "|".

Response: "UNB|UNB|BAL"

The sequence of responses is always "Master|Slave01|Slave02|…"

CASCade:ASSignment MASTer

Query commands that are issued in this operating mode always supply only a single query response. The channel specification for channel-related commands must be ≤ 8, otherwise there is an error message.

CASCade:ASSignment SLAVexx

Query commands that are issued in this operating mode always supply only a single query response. The channel specification for channel-related commands must be for R&S UPP200 ≤ 2, for R&S UPP400 ≤ 4, and for R&S UPP800 ≤ 8, otherwise there is an error message.

8.7.3.2 Query commands for measurement results

CASCade:ASSignment ALL

The regular `SENS:DATA` command is channel-based and, therefore, is sent to the corresponding instrument, e.g. `SENS:DATA20?` If the cascade has been composed only of 8-channel instruments, this command queries the measurement result of the 2nd slave and its channel 4. Switched off channels provide 9.91e+37 as a measurement result.

The measurement results for **all instruments** in the cascade are requested with `SENS:DATA:ALL?`: The measurement results of all channels of all instruments in the cascade come back in the sequence "Master|Slave01|Slave02|…" as a response.

Switched off channels are marked with "9.91e+37".

The 2, 4, or 8 measurement results of an individual instrument are separated by "," while the measurement result blocks per instrument are separated by "|".

Example of a response: "1.234 V,**9.91e+37**,1.234 V,**9.91e+37**,1.234 V,1.234 V,1.234 V,1.234 V|2.234 V,2.234 V,2.234 V,2.234 V,2.234 V,2.234 V,2.234 V,2.234 V|3.234 V, 3.234 V,3.234 V,3.234 V,3.234 V,3.234 V,3.234 V,3.234 V"

CASCade:ASSignment MASTer

Query commands that are issued in this operating mode always supply only a single query response. The channel specification for channel-related commands must be ≤ 8, otherwise there is an error message.

CASCade:ASSignment SLAVe xx

Query commands that are issued in this operating mode always supply only a single query response. The channel specification for channel-related commands must be for R&S UPP200 ≤ 2, for R&S UPP400 ≤ 4, and for R&S UPP800 ≤ 8, otherwise there is an error message.

8.7.3.3 The query command SYST:ERR?

CASCade:ASSignment ALL

Whenever an error message arises in a slave, it is sent to the master by an asynchronous event mechanism – without the user's help. The master enters the error message into its error queue with an ID on the string end (M for master, Sxx for the slaves), so that the source of the error message can be determined. Then the error queues of the slaves are empty.

The error queue is read with the `SYST:ERR?` command and can occur in the operating mode ALL as well as MASTer.

Example:

With `CASCade:ASSignment ALL`, followed by `INPut:TYPe BAL`, a command is sent to all instruments in the cascade that do not exist for the R&S UPP.

All instruments in the cascade generate an execution error.

The command `SYST:ERR?` now reads out the error queue of the master.

Example of a response: "-200,"Execution error;INP:TYPE BAL";**M**|-200,"Execution error;INP:TYPE BAL";**S01**|-200,"Execution error;INP:TYPE BAL";**S02**"

CASCade:ASSignment MASTer

All error messages accumulate in the master, its own and those of the slaves.

The error queue is read with the `SYST:ERR?` command and can occur in the operating mode ALL as well as MASTer.

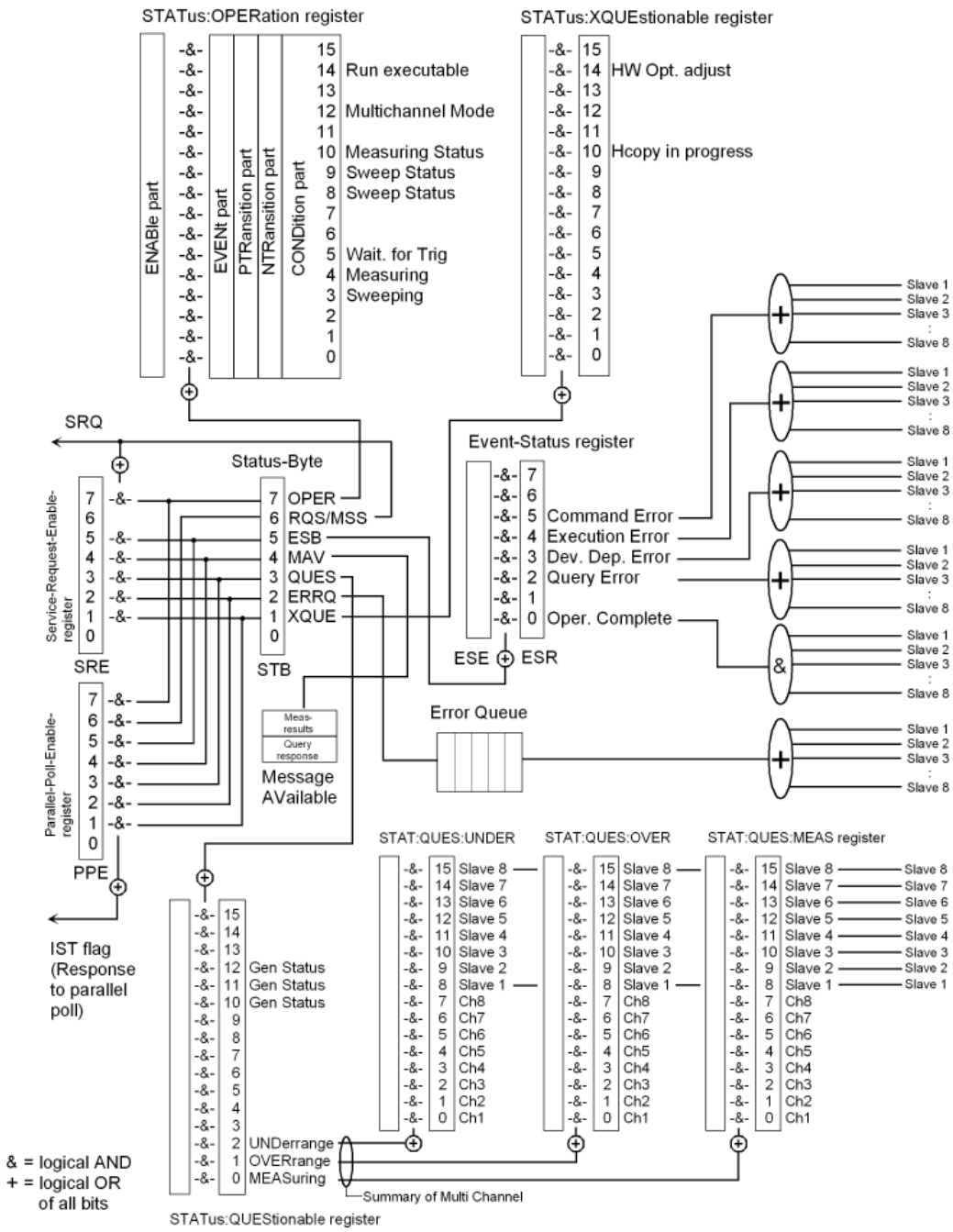
CASCade:ASSignment SLAVe xx

Since the slaves send error messages to the master immediately, the error queues of the slaves are always empty and therefore always send back "0,No error".

8.7.3.4 Cascading and Status Reporting System

The status registers

The status registers for the R&S UPP in conjunction with cascading appear as follows:



By comparison, the following illustration shows the status registers of an R&S UPP as a stand-alone instrument.

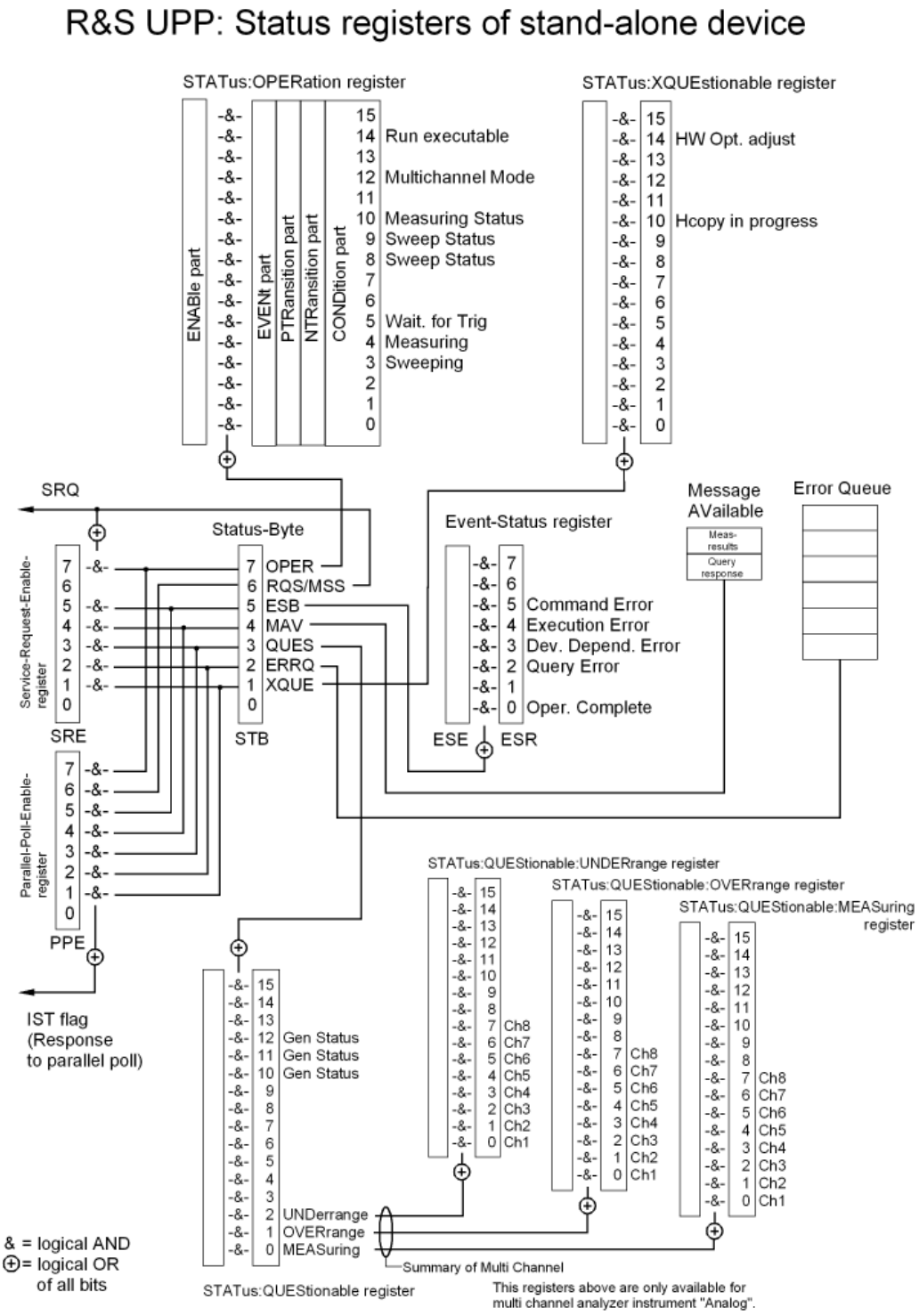


Fig. 8-12: Overview of Status Registers

Overview

The status system of the R&S UPP has only minor differences between cascaded mode and stand-alone mode. For a detailed description of the registers, refer to chap-

ter 6.8, "Status Reporting System", on page 634. The following extensions are active in cascaded mode:

Error queue	If an error occurs on a slave during remote control, it is entered into the error queue directly on the master. There, the error queue can be queried.
ESR register	If an error occurs on one of the slaves, the corresponding error bit is set immediately in the ESR register. The OPC bit for "Operation Complete" is not set until the last of the connected slaves is finished with the operation. Therefore, by querying this bit, one can wait until a measurement in the cascade is completely finished.
QUEStionable register	The summary bits for MEASuring, UNDERrange and OVERrange are extended by adding the channels of the connected slaves so that the user can see immediately if any of the connected channels is in one of the signaled states. However, to find out which exact channel this is, it is necessary to carry out a targeted query of the slaves.

8.7.3.5 SRQ in cascading

The SRQ behaves fully transparently in cascading: As the instruments in the cascade add to the basic status bits, the higher-level mechanism also works correctly: the OPC bit, for example, is not set until the last slave is finished with the measurement. Thus the interrupt is also not activated until the entire cascade is finished with the measurement.

8.7.3.6 Common commands in cascading

For the basic function of the common commands, see chapter 7.2, "Common Commands", on page 655. For an explanation of the extensions with regard to cascading, refer to:

Common command	**Cascade in operating mode `CASCade:ASSignment ALL`**
***RST**	**Reset** The master sends the command to all slaves and to itself and thus puts the entire cascade into PRESET state. All variables needed to transact the internal protocols between the instruments in the cascade (e.g. `*OPC`, `WAI`), are reset. This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.
***IDN?**	**Identification query** The master sends the command to all slaves and to itself, picks up the query responses and compiles all query responses, separated by "|", in the sequence Master, Slave01, Slave02, etc. Example: "Rohde&Schwarz,UPP,1146.2003k02/100009,2.1.68.0-2.4.1| Rohde&Schwarz,UPP, 1146.2003k02/100009,2.1.68.0-2.4.1| Rohde&Schwarz,UPP, 1146.2003k02/100009,2.1.68.0-2.4.1"

***OPT?**	**Option identification query** The master sends the command to all slaves and to itself, picks up the query responses and compiles all query responses, separated by **"|"** in the order Master, Slave01, Slave02 …. Example: "K1(01.00),K21(01.00),K22(01.00),K4(01.00),K6(01.00),K61(01.00),K7(01.00),K9(01.00),K91(01.00),K92(01.00),B1(01.00),B2(02.00),B42(02.00.1)| K1(01.00),K21(01.00),K22(01.00),K4(01.00),K6(01.00),K61(01.00),K7(01.00),K9(01.00),K91(01.00),K92(01.00),B1(01.00),B2(02.00),B42(02.00.1)| K1(01.00),K21(01.00),K22(01.00),K4(01.00),K6(01.00),K61(01.00),K7(01.00),K9(01.00),K91(01.00),K92(01.00),B1(01.00),B2(02.00),B42(02.00.1)"
***OPC?**	**Synchronization** Stops further command processing until 1 is returned. This is not the case until the 'Operation Complete' bit is set in the ESR. This bit indicates that the previous setting has been completed. The slaves report the OPC event to the master on their own. The master returns the value "1" to the control computer only when all OPCs have been received from all instruments. Caution: In case of nonsynchronization, "0" is **not** returned; instead, processing of commands is blocked! This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.
***OPC**	**Synchronization** Sets the Operation Complete bit in the ESR after processing all commands sent before *OPC. The slaves report the OPC event to the master on their own. Only after all OPCs from all instruments have arrived will the "Oper. Complete" bit in the ESR of the master be set. This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.

***WAI**	**Synchronization**
	Allows processing of the subsequent commands only after all previous commands have been carried out. The slaves report the OPC event to the master on their own. Processing of commands does not continue until all OPCs have been received from all instruments.
	Synchronization with `*WAI` is likely the most common used as follows:
	Example:
	`ASSignment:ALL`
	`INIT:CONT OFF;*WAI`
	`SENS:DATA1?`
	Read in response
	`SENS:DATA9?`
	Read in response
	`SENS:DATA17?`
	Read in response
	This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.

***TRG**	**Trigger** The master sends the command to all slaves and to itself. No acknowledge signal is required. After OPC, the measurement results can be retrieved. This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.

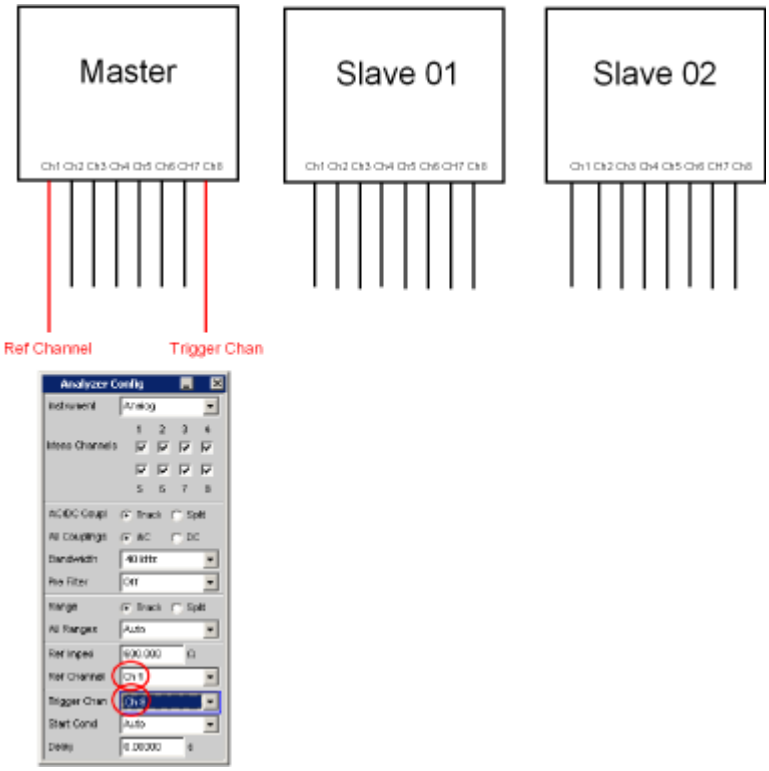
***CLS**	**Clear status** The master sends the command to all slaves, then to itself. All variables needed to transact the internal protocols between the cascaded instruments (e.g. *OPC, *WAI etc.) are reset. This command must not be used for the individual activation of a slave in the cascade and leads to an error message in the master error queue.
***ESE 0...255** ***EST?** ***IST?** ***SRE** ***STB?**	These common commands are evaluated by the master only. The master does not forward these commands to its slaves, as all slaves send their information to the master, which enters them in its registers as a summary with a conjunction or disjunction. These commands must not be used for individual activation of a slave in the cascade and lead to an error message in the master error queue.

8.8 Restrictions and Special Aspects

8.8.1 Reference and Trigger Channel

The parameter fields "Ref Channel" and "Trigger Chan" in the Analyzer Config Panel enable you to designate a reference channel for reference-related measurements and a trigger channel for deriving a trigger event for a measurement.

In the cascade, the parameter fields "Ref Channel" and "Trigger Chan" have a special meaning. These two parameter fields can be operated **in the master only**; therefore, the reference and trigger channels must always be wired to the master instrument.



To illustrate this, for all slaves in the cascade, the parameter fields "Ref Channel" are grayed out and identified with "Master" and "Trigger Chan" and identified with "Off". Unlike the master, all channels can be unchecked in the slaves, as there is no dependence to settings in Ref Channel and Trigger Chan. Even if all channels of a slave are unchecked, they are still included in the channel numbering, see chapter 8.3.4, "Numbering of the Channels", on page 814.

Without any action on the part of the user, to display reference-related measurement results, the value measured on the selected master channel is forwarded to the slaves and processed there. Likewise, the trigger condition is transmitted automatically from the selected master channel to the slaves, so that a synchronous measurement is ensured over all channels of the cascade.

8.9 Generators in a Cascade

The generators of the slaves are switched off by default. Afterwards, however, they can be operated.

8.10 Switcher Control in the Cascade

Each instrument in the cascade, whether a master or slave, can control a switcher or cascade of switchers. Normally, however, a switcher is always connected to the master instrument. In "GUI Control" = "All" or `CASCade:ASSignment ALL`, switcher com-

mands are **not** forwarded to the slaves, as usually, no switcher is connected there and the switching operations in the switchers would surely not be suitable for the usual measurement tasks.

On the other hand, in the operating mode "GUI Control" = "Slave xx" or `CASCade:ASSignment SLAVe xx`, a switcher (or a cascade of switchers) connected to a slave instrument can be addressed in a targeted manner.

Cascading switchers by connecting one switcher each to an instrument of the R&S UPP cascade is **not possible!** Now as before, switchers are cascaded using RS232 connections and daisy chain. The switcher cascade must be activated by a single R&S UPP!

For connecting a switcher, refer to chapter 5.41.1, "Connecting the Switcher to the R&S UPP", on page 465.

9 Maintenance and Instrument Interfaces

9.1 Introduction - Maintenance and Interfaces

The following chapter contains information on maintaining the audio analyzer and also describes the instrument interfaces.

How to change a module and order spare parts is described in the service manual. The service manual also contains all the ID numbers required for ordering spare parts. The service manual is available as PDF file on the user documentation CD ROM (included in delivery).

The address of our Support Center and a list of Rohde & Schwarz Service Centers are given at the beginning of this manual.

More detailed information (especially on troubleshooting, repairing the instrument, changing the modules and calibration) can also be found in the service manual.

9.2 Maintenance

The audio analyzer does not require regular maintenance. Maintenance is essentially restricted to cleaning the instrument. It is, however, advisable to check the nominal data from time to time.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument. Never use solvents such as thinners, acetone, as these substances will damage plastic components and the labeling on the front panel.

The outside of the instrument is suitably cleaned using a soft, line-free dust cloth.

The storage temperature range for the audio analyzer is specified in the data sheet. The instrument must be protected against dust if it is to be stored for a long period.

When transporting or shipping the instrument, it is advisable to use the original packing material (especially the two protective covers for the front and rear panel).

9.3 Changing the AC Supply Fuse

Only fuses of the type IEC 127T4.0H/250V should be used. Those fuses are used for all of the specified nominal AC supply voltages.

NOTICE

Damage of instrument when using wrong fuses

Using wrong fuses may cause damage of the instrument.

Changing the AC supply fuses:

1. Disconnect the power cable.
2. Pry out the fuse holder with two small screwdrivers or similar tools.
3. Remove both fuses and install new ones.
4. Reinsert the fuse holder.

9.4 Instrument Interfaces

The following section describes the remote-control interfaces of the audio analyzer and the pin assignment of the monitor socket. The other interfaces are described in chapter 2, "Putting into Operation", on page 21.

9.4.1 IEC/IEEE-Bus Interface (IEC 625 / IEEE 488)

As standard, the instrument is equipped with an IEC/IEEE-bus connector. The connector socket (conforming to IEEE 488) is at the rear of the instrument. The interface can be used to connect a controller to allow remote control of the instrument. A shielded cable is used for connection.

9.4.1.1 Features of the IEC/IEEE-bus interface

- 8-bit parallel data transfer
- Bidirectional data transfer
- Three-wire handshake
- High data transfer rate
- Up to 15 instruments can be connected
- Max. length of connecting cables: 15 m (individual connection 2 m)
- Wired-Or operation with parallel connection of several instruments

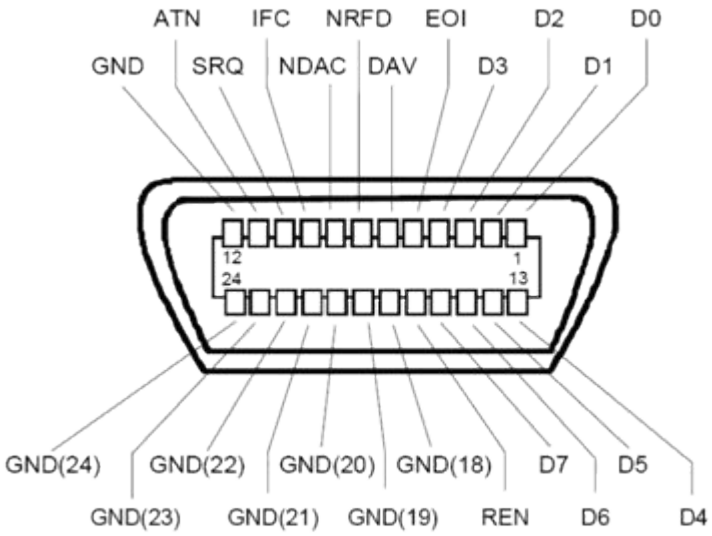


Fig. 9-1: Pin assignment of IEC/IEEE-bus interface

9.4.1.2 IEC/IEEE-bus lines

- **Data bus with 8 lines DIO 1...DIO 8**
  Data is transferred parallel by bit and serial by byte in ASCII/ISO code. DIO1 is the bit with the lowest value and DIO8 the bit with the highest value.
- **Control bus with 5 lines:**
  - **IFC** (Interface Clear):
    Active LOW resets the interfaces of the connected instruments to their initial setting.
  - **ATN** (Attention):
    Active LOW signals the transmission of interface messages
    non-active HIGH indicates the transmission of device messages
  - **SRQ** (Service Request):
    Active LOW allows the connected instrument to send a service request to the controller.
  - **REN** (Remote Enable):
    Active LOW allows switchover to remote-control mode.
  - **EOI** (End or Identify):
    This has two functions in conjunction with ATN:
    ATN = HIGH Active LOW indicates the end of data transfer.
    ATN = LOW Active LOW triggers a parallel poll.
- **3. Handshake bus with three lines:**
  - **DAV** (Data Valid):
    Active LOW signals a valid data byte on the data bus.
  - **NRFD** (Not Ready For Data):
    Active LOW signals that one of the connected instruments is not ready to receive data.

– **NDAC** (Not Data Accepted):
Active LOW while the connected instrument is receiving the data on the data bus.

9.4.1.3 IEC/IEEE-bus interface functions

Instruments which can be remote-controlled via the IEC/IEEE bus can be provided with various interface functions. The table below lists the interface functions which apply to the audio analyzer.

Table 9-1: Interface functions

Control character	Interface functions
SH1	Source handshake, full capability
AH1	Acceptor handshake, full capability
L4	Listener function, full capability, unaddressing by MTA
T6	Talker function, full capability, capability of responding to serial query, unaddressing by MLA
SR1	Service request function, full capability
PP1	Parallel poll function, full capability
RL1	Remote/local switchover function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability
C0	No controller function

9.4.1.4 IEC/IEEE-bus interface messages

Interface messages are transferred to the instrument on the data lines, whereby the "attention" control line ("ATN") is active (LOW). They are used for communication between the controller and the instrument and can only be sent by a controller which has controller functionality on the IEC/IEEE bus.

Universal commands

The universal commands are in the code range 0x10 to 0x1F. They act on all instruments connected to the bus without previous addressing.

Table 9-2: Universal commands

Command	VISUAL BASIC command	Effect on instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not modify the instrument configuration.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to their initial setting.

Command	VISUAL BASIC command	Effect on instrument
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	The manual LOCAL switchover function is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial polling
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial polling
PPU (Par. Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of parallel polling query status

Addressed commands

The addressed commands are in the code range 0x00 to 0x0F. They only act on instruments which are addressed as listeners.

Table 9-3: Addressed commands

Command	VISUAL BASIC command	Effect on instrument
SDC (Selected Device Clear)	IBCLR (device%)	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not modify the instrument configuration.
GET (Group Execute Trigger)	IBTRG (device%)	Triggers a measurement or a sweep.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual operation)
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel poll. The VISUAL BASIC command also executes PPE/PPD.

9.4.2 Ethernet Interface (LAN)

As standard, the instrument is equipped with an Ethernet interface. The connector socket is at the rear of the instrument. Network administrators with the appropriate rights can transfer files across the network and use network resources such as network directories or printers. The instrument can also be remote-controlled and manually operated in the network. A commercially available RJ-45 cable is used for connection.

The network card operates with 100-MHz-Ethernet IEEE 802.3u. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP provides connection-mode communication where the sequence of the exchanged messages is retained and interrupted connections are detected. Furthermore, messages cannot be lost if this protocol is used.

Connection of the R&S UPP is described in chapter 2.10.1, "Connection to the Network", on page 44, and remote control via Ethernet is described in chapter 6.3.2, "Remote Control via LAN Interface", on page 612. The architecture of a LAN remote-control connection is described in greater detail below.

Remote control of the instrument via a network is based on these standardized protocols which comply with the OSI reference model (see the figure below).

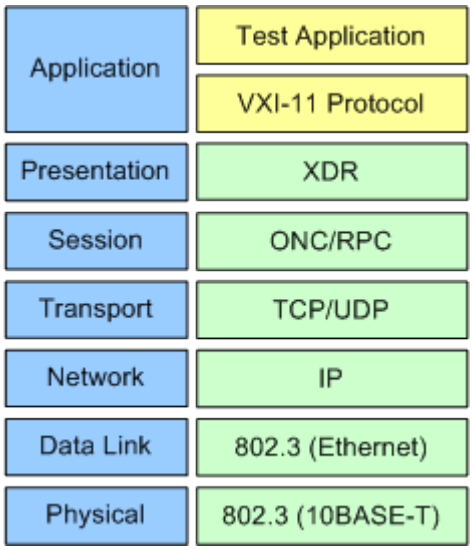


Fig. 9-2: Example of LAN remote control in compliance with OSI reference model (VXI-11)

Based on TCP/UDP, the messages are exchanged between the controller and the instrument by means of Open Network Computing (ONC) Remote Procedure Calls (RPC). With XDR, the permitted RPC messages are known as the VXI-11 standard. Messages are exchanged between the controller and the instrument based on this standard. The messages are identical to the SCPI commands. They can be divided into four groups: program messages (control commands to the instrument), response messages (values returned by the instrument), service request (spontaneous requests by the instrument) and low-level control messages (interface messages).

A VXI-11 connection between a controller and an instrument is based on three channels: core, abort and interrupt channel. The instrument is controlled mainly via the core channel (program, response and low-level control messages). The abort channel is used for immediate termination of the core channel, and the interrupt channel transports spontaneous service requests from the instrument. The actual connection setup is complex. Further details can be found in the VXI-11 specification ('TCP/IP Instrument Protocol Specification VXI-11, Revision 1.0 VMEbus Extensions for Instrumentation, VXIbus' and 'TCP/IP-IEEE 488.2 Instrument Interface Specification VXI-11.3, Draft 0.3 VMEbus Extensions for Instrumentation, VXIbus').

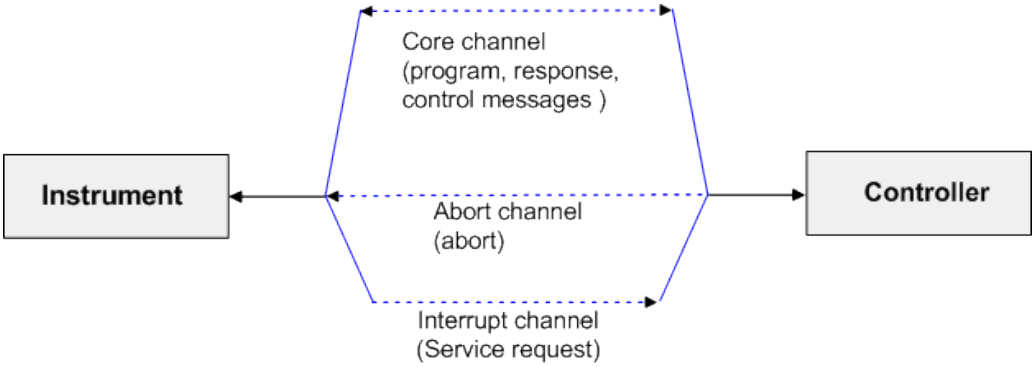


Fig. 9-3: Channels between instrument and controller with VXI-11

The number of controllers which can access an instrument is virtually unlimited in the network. In the instrument, a clear distinction is made between the individual controllers. This distinction is continued down to one controller at application level, i.e. two applications on a PC are regarded as two different controllers by an instrument.

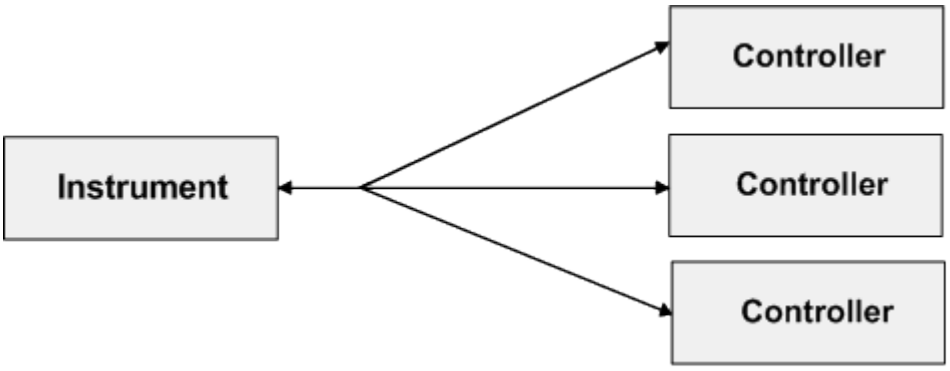
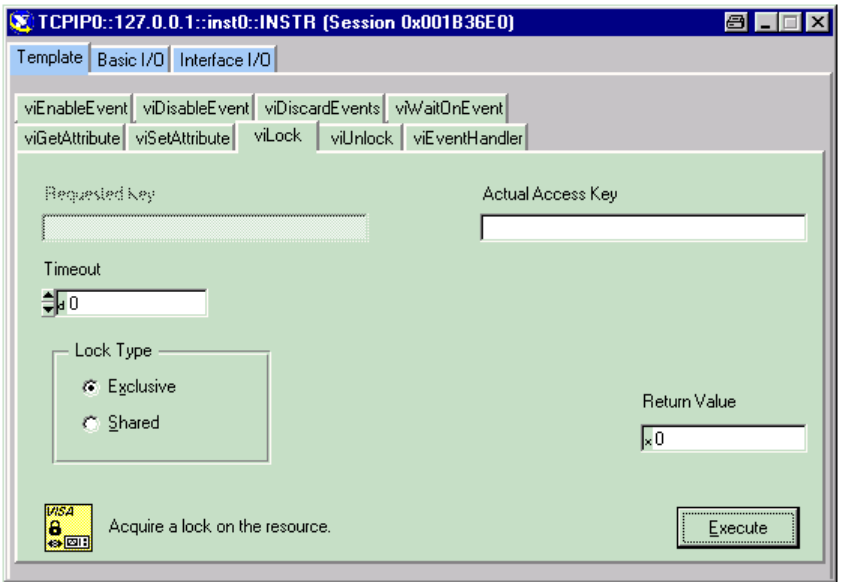


Fig. 9-4: Remote control via LAN with several controllers

The controllers can lock and unlock the instrument to permit exclusive access. As a result, it is possible to control access from several controllers.

In the program 'Measurement and Automation Control', this setting is made in the Template panel.



9.4.2.1 VXI-11 interface messages

With Ethernet connections, the interface messages are referred to as low-level control messages. They can be used to emulate the interface messages of the IEC/IEEE bus.

Table 9-4: VXI-11 interface messages

Command		Effect on instrument
&ABO	(Abort)	Terminates processing of commands that have just been received.
&DCL	(Device Clear)	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not modify the instrument configuration.
&GTL	(Go to Local)	Transition to the "Local" state (manual operation).
&GTR	(Go to Remote)	Transition to the "Remote" state (remote control).
&GET	(Group Execute Trigger)	Triggers a measurement or a sweep.
&LLO	(Local Lockout)	The manual LOCAL switchover function is disabled.
&POL	(Serial Poll)	A serial poll is executed.
&NREN	(Not Remote Enable)	Manual switching to LOCAL mode is enabled.

9.4.3 USB Connectors (USB)

As standard, the instrument has four USB interfaces (Universal Serial Bus) of type A (Master USB); they form a link with the internal processor. They can be used to connect peripherals such as a mouse and keyboard or to connect a USB stick for transferring files. Two of the USB interfaces are on the front of the instrument and two are on the rear of the instrument.

9.4.4 USB Device Port

Instruments of the new generation have a Type B USB device connector on the rear panel in addition to the normal USB connector. The Type B connector is commonly used for hubs and external hard disk drives. The RS UPP can also be controlled via this port if the controller has the necessary drivers.

Remote control via USB is described in chapter 6.3.3, "Remote Control via the USB Device Interface", on page 616.

9.4.4.1 USB device interface messages

In the case of a USB device link, the interface messages are called "Low-Level Control Messages". They can be used to emulate the interface messages of the IEC/IEEE bus.

Table 9-5: USB device interface messages

Command		Effect on instrument
&ABO	(Abort)	Terminates processing of commands that have just been received.
&DCL	(Device Clear)	Ends processing of the commands that were just received and sets the command processing software to a defined initial state. Does not modify the instrument configuration.
&GTL	(Go to Local)	Transition to the "Local" state (manual operation).
&GTR	(Go to Remote)	Transition to the "Remote" state (remote control).
&GET	(Group Execute Trigger)	Triggers a measurement or a sweep.
&LLO	(Local Lockout)	The manual LOCAL switchover function is disabled.
&POL	(Serial Poll)	A serial poll is executed.
&NREN	(Not Remote Enable)	Manual switching to LOCAL mode is enabled.

List of Commands

*CLS....656
*ESE....656
*ESR?....656
*GTL?....656
*IDN?....656
*IST?....657
*OPC....657
*OPC?....657
*OPT?....657
*PRE....657
*PSC....658
*RST....658
*SRE....658
*STB?....658
*TRG....658
*WAI....659
ABORt....703
ARM:FREQuency:STARt....704
ARM:FREQuency:STOP....705
ARM:LEVel:MIN....705
ARM:VOLTage:STARt....705
ARM:VOLTage:STOP....705
AUXiliaries:AUDMonitor....741
AUXiliaries:SIGSource....741
AUXiliaries:SPEaker:MONitor<n3>....741
AUXiliaries:SPEaker:SOURce<n3>....742
AUXiliaries:SPEaker:VOLume<n3>....742
AUXiliaries:TRIGger:OUTPut:DELay....742
AUXiliaries:TRIGger:OUTPut:ENABle....742
AUXiliaries:TRIGger:OUTPut:MODE....742
AUXiliaries:VOLTage<n2>....742
DATA:BARGraph:COUNt:X<n4>?....717
DATA:BARGraph:COUNt:Y<n4>?....717
DATA:BARGraph:X<n3>?....718
DATA:BARGraph:Y<n3>?....718
DATA:FFT:COUNt:X<n4>?....717
DATA:FFT:COUNt:Y<n4>?....717
DATA:FFT:X<n3>?....718
DATA:FFT:Y<n3>?....718
DATA:SWEep:COUNt:X<n4>?....717
DATA:SWEep:COUNt:Y<n4>?....717
DATA:SWEep:X<n3>?....718
DATA:SWEep:Y<n3>?....718
DISPlay:BARGraph<n2>:A:BOTTom....753
DISPlay:BARGraph<n2>:A:CHANnel....754
DISPlay:BARGraph<n2>:A:LABel:AUTO....754
DISPlay:BARGraph<n2>:A:LABel:USER....754

DISPlay:BARGraph<n2>:A:LEGend:DESCription....754
DISPlay:BARGraph<n2>:A:LEGend:SHOW....755
DISPlay:BARGraph<n2>:A:LIMLower....755
DISPlay:BARGraph<n2>:A:LIMLower:SOURce....755
DISPlay:BARGraph<n2>:A:LIMLower:SOURce:FILE....756
DISPlay:BARGraph<n2>:A:LIMLower:SOURce:VALue....756
DISPlay:BARGraph<n2>:A:LIMShift....756
DISPlay:BARGraph<n2>:A:LIMShift:PARallel....756
DISPlay:BARGraph<n2>:A:LIMShift:SYMMetrical....757
DISPlay:BARGraph<n2>:A:LIMUpper....757
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce....757
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:FILE....758
DISPlay:BARGraph<n2>:A:LIMUpper:SOURce:VALue....758
DISPlay:BARGraph<n2>:A:NORMalize....758
DISPlay:BARGraph<n2>:A:NORMalize:VALue....758
DISPlay:BARGraph<n2>:A:REFerence....759
DISPlay:BARGraph<n2>:A:REFerence:FILE....759
DISPlay:BARGraph<n2>:A:REFerence:VALue....759
DISPlay:BARGraph<n2>:A:SPACing....759
DISPlay:BARGraph<n2>:A:TOP....760
DISPlay:BARGraph<n2>:A:UNIT....760
DISPlay:BARGraph<n2>:A:UNIT:AUTO....760
DISPlay:BARGraph<n2>:A:UNIT:TRACk....760
DISPlay:BARGraph<n2>:A:UNIT:USER....761
DISPlay:BARGraph<n2>:A:UPDate....761
DISPlay:BARGraph<n2>:A:YSOurce....761
DISPlay:BARGraph<n2>:A:YSOurce:FILE....762
DISPlay:BARGraph<n2>:B:BOTTom....753
DISPlay:BARGraph<n2>:B:CHANnel....754
DISPlay:BARGraph<n2>:B:LABel:AUTO....754
DISPlay:BARGraph<n2>:B:LABel:USER....754
DISPlay:BARGraph<n2>:B:LEGend:DESCription....754
DISPlay:BARGraph<n2>:B:LEGend:SHOW....755
DISPlay:BARGraph<n2>:B:LIMLower....755
DISPlay:BARGraph<n2>:B:LIMLower:SOURce....755
DISPlay:BARGraph<n2>:B:LIMLower:SOURce:FILE....756
DISPlay:BARGraph<n2>:B:LIMLower:SOURce:VALue....756
DISPlay:BARGraph<n2>:B:LIMShift....756
DISPlay:BARGraph<n2>:B:LIMShift:PARallel....756
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DISPlay:BARGraph<n2>:B:LIMUpper....757
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce....757
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce:FILE....758
DISPlay:BARGraph<n2>:B:LIMUpper:SOURce:VALue....758
DISPlay:BARGraph<n2>:B:NORMalize....758
DISPlay:BARGraph<n2>:B:NORMalize:VALue....758
DISPlay:BARGraph<n2>:B:REFerence....759
DISPlay:BARGraph<n2>:B:REFerence:FILE....759
DISPlay:BARGraph<n2>:B:REFerence:VALue....759
DISPlay:BARGraph<n2>:B:SPACing....759

DISPlay:BARGraph<n2>:B:TOP....760
DISPlay:BARGraph<n2>:B:UNIT....760
DISPlay:BARGraph<n2>:B:UNIT:AUTO....760
DISPlay:BARGraph<n2>:B:UNIT:TRACk....760
DISPlay:BARGraph<n2>:B:UNIT:USER....761
DISPlay:BARGraph<n2>:B:UPDate....761
DISPlay:BARGraph<n2>:B:YSOurce....761
DISPlay:BARGraph<n2>:B:YSOurce:FILE....762
DISPlay:BARGraph<n2>:DLISt:FILTer....762
DISPlay:BARGraph<n2>:MCHMode....763
DISPlay:BARGraph<n2>:MINMax....763
DISPlay:BARGraph<n2>:OCURsor:MODE....781
DISPlay:BARGraph<n2>:OCURsor:POSMode....782
DISPlay:BARGraph<n2>:OCURsor:SETTo:MAX....783
DISPlay:BARGraph<n2>:OCURsor:SETTo:MIN....784
DISPlay:BARGraph<n2>:OCURsor:SETTo:XPOS....785
DISPlay:BARGraph<n2>:OCURsor:SETTo:YPOS....785
DISPlay:BARGraph<n2>:OCURsor:STATe....786
DISPlay:BARGraph<n2>:OCURsor:Y?....786
DISPlay:BARGraph<n2>:SCANoffset....710
DISPlay:BARGraph<n2>:TITLe:DESCription....764
DISPlay:BARGraph<n2>:TITLe:SHOW....764
DISPlay:BARGraph<n2>:TRACk:LIMit....764
DISPlay:BARGraph<n2>:TRACk:REFerence....764
DISPlay:BARGraph<n2>:TRACk:SCALing....764
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